

APRIL

Reg. U.S. Pat. Off.

25 C

Popular Science

Founded MONTHLY 1872

★

300
Pictures



Fumigating Sick Trees—See Page 63

Choose your tires the same way a car owner does-

IT WOULD interest you to stand in a garage on a busy Saturday afternoon and see the way car owners come in and say: "Give me a U. S. Royal Cord. Give me a U. S. Chain Tread."

Those car owners know what the name U. S. means on a tire. And their confidence in the U. S. quality is the same confidence you can have in buying your bicycle tires, if you only say "U. S."

Look at that U. S. Cord Tire shown in the picture. And the U. S. Chain Tread Tire alongside. They are *bicycle* tires—but they are made in exactly the same design and with exactly the same care as their "big brother" U. S. Automobile Tires. They deliver the same kind of service—non-skid and long wear.

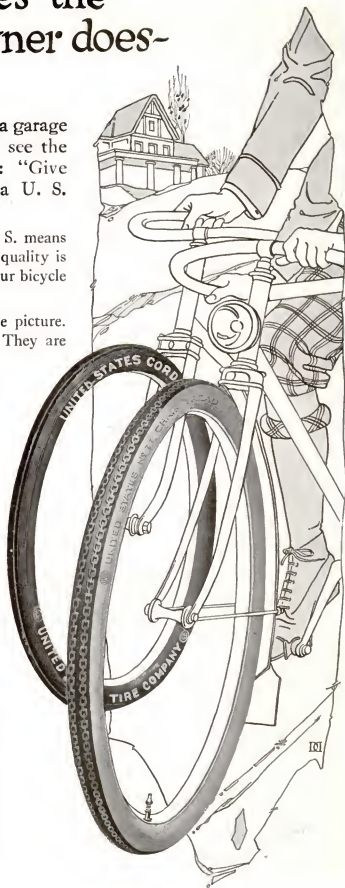
Few tire makers devote the same attention to bicycle tires as to automobile tires. If you have been having trouble with your bicycle tires, that's probably the reason.

The United States Rubber Company has a high reputation to maintain, not only in automobile tires, but in bicycle tires as well. U. S. Bicycle Tires must live up to that reputation all the way through.

Find the dealer who sells good bicycles and U. S. Tires—the two go together.

If you want to know about the rubber that goes into U. S. Bicycle Tires write for a copy of the graphically illustrated and fascinatingly written book, "Rubber—A Wonder Story."

There are nine styles of U. S. Bicycle Tires, both clincher and single tube: U. S. Chain Tread, U. S. Cords, Giant Stud, G & J Corrugated, G & J Chain Tread, G & J Herringbone, Heavy Service, Overland Thornproof, Nonpareil. Choose the tread you like best from your dealer's stock.



United States Tires

United States Rubber Company



*The Quartet
from Rigoletto*

Victor Records

As famous for their fidelity
as for the artists they present

Absolute faithfulness of reproduction is the one essential the greatest artists demand in the making of talking-machine records.

Because of their dominant position in the world of music, because of the pride they take in their art, it is a prime requisite that their interpretations shall be reproduced in all their original beauty.

It is highly significant that the world's greatest singers and instrumentalists have entrusted their art to the Victor and Victor Records as the one medium through which they themselves wish to be heard.

There are Victrolas in great variety of styles from \$25 to \$1500, and any Victor dealer will gladly play any music you wish to hear. New Victor Records demonstrated at all dealers on the 1st of each month.

Victor Talking Machine Co.

Camden

New Jersey



NEW - Vol. 42 in the Famous Cypress Pocket Library!

The Cypress Bird-House Book

20 Working Plans
on double supplement2 rare portraits of AUDUBON
on special supplement. Suitable for framing

Well, we suppose you'd better
GET THAT BOY TO WRITE
right away for this very special

Vol. 42 of the internationally
famous Cypress Pocket
Library. Just out.

"Good Bungalows for Good Birds."

It is a wonderful compilation of bird lore and bird information. **BIG DOUBLE SUPPLEMENT WITH 20 BEAUTIFUL AND CORRECT DESIGNS**—all specially made by artists who know birds. (Not one is like the other good designs in bird house catalogs.) Also in this volume you will find

20 FULL WORKING PLANS

with Complete Specifications. And ALSO EXTRA ART SUPPLEMENT, 12 x 29 inches, in FIVE COLORS with a total of

3 PORTRAITS OF AUDUBON

SUITABLE FOR FRAMING, two of them being reproductions in 5 colors of 2 rare old steel engravings, also photograph of his home and of the Statue to his memory. ALSO

5 BIRDS in NATURAL COLORS

and 180 correct pen portraits of other birds—with calls.

"Your Cypress Volume 42 is one of the most complete and authentic books on this subject I have ever seen."
Thus recently wrote a bird-lover who has read much.

You will be astonished and delighted with the variety of the contents of Vol. 42. And it is FREE. Send your name. Today is best.

SOUTHERN CYPRESS MFRS' ASSN.

1249 Hibernia Bank Bldg., New Orleans, La., or
1249 Heard Nat'l Bank Bldg., Jacksonville, Fla.



Popular Science Monthly

APRIL, 1920
Volume 96-No. 4

CONTENTS

AERONAUTICS

	Page
The Air Pilot as a Surveyor.....	25
They Built Their Air Flyer.....	25
The Seaplane's Carrier.....	45
Class Distinction in the Air.....	57
Shipping a Note to the Pilot.....	63
Taking Your Good Road Along with You.....	68

INDUSTRIAL PROGRESS

Uncle Sam in the Glass Business.....	24
Heat and Heat Rivets by Electricity.....	24
How the Air in Deep Mines is Cooled.....	24
A Truck for the Maid's Use.....	27
Do You Wear Shark-Skin Shoes?.....	28
The Hardest Tool-Steel Yet Discovered.....	28
Exit the Old Oak Bucket.....	28
Making the Cool Stove into an Oil-Burner.....	36
Pack the Barrel Tightly.....	36
Cutting Iron Plates into Ribbons.....	36
Finding Oil with Electricity.....	36
Try a Sample, Lady?.....	37
A Motor-Turned Screwdriver.....	37
A Monster Steel-Rolling Machine.....	38
Juggling Heavy Loads in Mid-Air.....	39
Making Steel that Is Hard or Soft.....	44
The Shoe that Won't Strike Sparks.....	44
Apricot Pits for Dyestuffs.....	46
Opening the Door Connects You with "Central".....	46
Tiny Model Houses Show What You'll Live In.....	46
How They Clear Snow in Berlin.....	47
To Get the Lid Off an Egg-Grate.....	51
An Electric Steam Heater.....	54
Follow the Sound of the Horn to the Fire.....	55
He Enjoys Using This Riveting-Machine.....	56
Speeding Up the Water-Wheel.....	58
One Hundred Tons in a Lump of Steel.....	60
Efficiency in Sealing Envelopes.....	60
To the Bottom of the Sea in an Automobile.....	62
Turn the Crank and Clean Your Gloves.....	63
The Truck that Does Its Own Log-Loading.....	67
Masks for Welders.....	68
Heating Rivets in a New Way.....	75
Let the Truck Lift It.....	77
It Simplifies Cutting Circles in Glass.....	83

MEDICINE AND SURGERY

They Are Going West for a Separation.....	46
A Bath-Tub for Sun-Baths.....	77

(Continued on page 9)

Copyright, 1920, by the Modern Publishing Company, Popular Science Monthly is published monthly. Yearly subscription in the United States, \$3.00; Canada, \$3.50. Foreign, \$4.00. Single copy, 25 cents.

Popular Science Monthly may be had at all newsstands in the United States and Canada; also from the International News Company, London, and at Brentano's, Paris.

Advertising rates on application. Forms close the twelfth of the second month preceding date of publication. Entered as second-class matter Dec. 28, 1915, at the Post Office at New York under the act of March 3, 1879. Entered as second-class matter at the Post Office Department, Canada.

The contents of this magazine are copyrighted and must not be reprinted without permission. H. J. Fisher, President; R. C. Wilson, Vice-President; O. B. Capen, Secretary and Treasurer.

Modern Publishing Company
225 West Thirty-ninth St. New York City

Learn To Talk Convincingly

—and the World is at Your Feet

WHY can one man sell where another fails? Why can one man literally carry an audience off its feet, while another, speaking on the same subject, makes little or no impression? Why can one man get the sought-after job when another better qualified is turned down? Why does everyone "believe in" one man and have no



An interesting and convincing talker is popular—the center of attraction at all social affairs.

confidence in another who really has just as much ability? The thing that counts is

Not Only WHAT You Say But HOW You Say It

The world is full of splendid merchandise that doesn't move—"order takers" who should be salesmen—political ideas that meet continual defeat—good men earning less, much less, than they're worth; all because so few know how to use that God-given faculty of speech which is one of man's greatest weapons.

Let Me Teach You

I can teach you how to carry conviction—how to make what you say



If your words carry conviction you can influence a crowd to think as you do.

have the effect you want it to, whether you talk to sell, to convince or to entertain. I can enable you to overcome timidity—give you confidence in yourself, develop your personality, improve your memory.

I can show you the art of brevity, the value of silence. Instead of being funny at the wrong time, I can suggest when and how to use humor with telling effect. Do you know the knack of making oral reports to superiors? Do you know the right and wrong way of presenting complaints, estimates, and to issue orders?

CAN YOU DO THIS?

Can you talk as well in public as at home?
Can you get financial backing when you want it?
Can you win confidence, friendship, love through your speech?
Can you give humorous, extemporaneous talks?

Can you make people listen when you talk?
Can you hold your hearers spell bound?
Can you address any size audience from one to thousands?
Can you get up and talk, any time, any place without nervousness?

I can show you how to answer complaints, how to ask the bank for a loan, how to ask for an extension on your note. Another valuable lesson I teach is how—instead of antagonizing people when they disagree with you, you may swing them around to your way of thinking in a pleasant sort of way. You will learn the best way to get things done—the secrets of diplomacy.

Results in One Evening

Now one of the remarkable things about my method is that it requires little study and time.



Among strangers or at home people listen eagerly.

Nearly anyone can grasp the principles in an evening. Hundreds of letters pour in every day proving that my method brings almost immediate results.

Thousands Have Benefited

Among the enthusiastic students of my Course are thousands of prominent men in all walks of life—they include business men, preachers, lawyers, teachers, physicians, bankers, etc., etc.

Frederick Houk Law.



At a committee or board of directors' meeting you will be able to hold attention when you talk.

The Independent Corporation, publishers of "Mastery of Speech," Dr. Law's Course in Business Talking and Public Speaking, are offering you an opportunity to learn in your own home how to improve your ability to



The ability to talk convincingly will win over prominent men. It is one of the secrets of closing big deals.

Talk Convincingly. They are so confident that you will see its possibilities that they are willing to send it to you for free examination.

Send No Money

You send no money. Just mail the coupon and, all charges prepaid, you will receive the Course—you are under no obligation whatever—and if you are not entirely satisfied send it back any time within five days after you get it—you will owe nothing.

But if you are pleased, as thousands of others have been who have used the Course, it will cost you only \$5.00 in full payment. You have everything to gain and nothing to lose. Act immediately before this offer is withdrawn.

PERSONAL EXPERIENCES:

"The very day after examining 'Mastery of Speech,' I had the confidence to go up and ask my superintendent for a transfer on the planters. And, to my surprise, he gave it to me. I had for months been wanting that change, but didn't have the confidence until your Course pointed out the way to talk to your 'superior.' That is only one incident where your 'Course was of value.'"
RALPH L. LEONARD,
40 Bridge Street,
Beverly, Mass.

"After a careful personal of the Course, I am convinced that correct speech is the largest contribution to a man's success, and that most application to the study of this Course will produce the desired perfection in speech."
H. W. CROSS, 1882 W. Main Street, Guthrie, Okla.

"I have had the Course only a few days but have already noted considerable improvement in speech and in ability to make and entertain persons I'm associated with. I am much pleased with it."
OLAF A. BLOMGREN,
Lillies, O. M. C.,
Camp Lewis, Washington.

"I have read but one page—positively not another word—and I have found in that page the magical keynote which vibrates with my longings to be, and may believe that, with their help, I will become a good public speaker, despite an agonizing diffidence inherited from my mother."

CHAS. COURTLAND SMITH, 582 Hartford Bldg., Chicago, Ill.

Independent Corporation

Dept. L-774, 119 W. 40th St., New York City

Independent Corporation

Publishers of the Independent Weekly

DEPT. L-774, 119 W. 40th St., New York City

- ☐ Mastery of Speech
- ☐ By Frederick Houk Law
- ☐ Both Men and Women
- ☐ By David M. Roth
- ☐ How to Become a Character at Sight
- ☐ By Dr. R. M. H. Hiseckford
- ☐ Super-Successful
- ☐ By Arthur Newbush
- ☐ Fundamentals of Personal Efficiency
- ☐ By Edward Zerk Purinton
- ☐ Yerrin Home-Account System (F3)
- ☐ By Wesley W. Ferrin

Name.....

Address.....

Make a Bigger Income.

Learn Draftsmanship



Great demand for draftsmen now. Still greater demand in prospect. War over, buildings to be resumed, and manufacturing to expand to meet home and foreign needs—which means plenty of good positions for draftsmen. Take up this paying profession. The Chicago "Tech" method is the quickest, easiest way to become a draftsman in spare time while you hold your present position. That proved before you pay a penny. (See free lesson offer below.)

Send coupon. Learn how to earn

\$25 to \$100 a Week or More

at interesting work with opportunities to rise to superintendent, manager, or other executive positions. Let the Chicago "Tech" engineers train you. At least get the free lesson and information.

Drawing Outfit Easy Payments

(No Extra Charge)

Every student of the Chicago "Tech" Home Study Course in Draftsmanship receives this drawing outfit—set of instruments in case, drawing board, T square, triangles, scale, curve, drawing paper, pencils, etc., or a cash credit in case already has an outfit. These instruments are of the same make and size as used by high salaried experts in drafting rooms of factories, shops, railroads, etc. You use them while learning—then take them right into your practical work.

NOTE: You have the personal direction of practical engineers, builders and architects who teach you the methods they use in their own offices. No waiting, no time wasted. You are prepared to learn inside out, experienced, the advantage to borrow from a staff like this every man a specialist.

Come to the College or TRAIN AT HOME

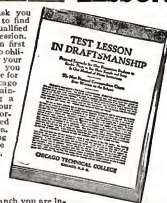
Wherever you are you can have this Chicago "Tech" training. Complete instruction by mail. Exercises, lessons, personal direction of our experts right in your own home if you cannot come to the college for a resident course. Send the Coupon and get the facts.

FREE TEST LESSON

Other institutions ask you to pay first—and then to find out later how well qualified you are for this profession. We send the free lesson first and place you under no obligation at all. Discover your qualifications before you pay anything. And see for yourself just what Chicago "Tech" offers you in training which will bring a ready market for your services and open opportunities which are closed to the untrained man. The coupon will bring all the facts about the course, the small fee, and the easy terms.

NOW

Mark with X the branch you are interested in—or if in doubt about which course to take, write a letter stating facts about yourself and asking our advice, which will be freely given. Mail either the coupon or the letter today.



Auto and Gas Engine Course

All about automobile mechanism—its construction, operation and REPAIRS—taught by mail. You train directly under the Chicago "Tech" automobile experts. splendid opportunities open now.

- Learn All This in Spare Time**
- All about Gasoline Engines.
 - All about Power Plants and Transmissions.
 - All about Carburetors and Fuel Supply Systems.
 - All about Lubrication and Cooling.
 - All about Batteries.
 - All about Magnet Ignition.
 - All about Starting and Lighting Systems.

AERONAUTICS

Complete course in Aeromobile Engineering. Every principle made clear. Equip you for export work. Send the coupon and get catalog and all information now.

Write

CONTENTS—Continued

MOTOR VEHICLES AND ACCESSORIES

A Tractor from a Stationary Farm Engine.....	34
The Automobile Jack on Wheels.....	34
A One-Man Street-Cleaning Tool.....	34
A Simple Lathe Used for Grinding Valves.....	35
Washing Eight Hundred Cars a Day.....	35
Oil-Tanks Now Filled by Compressed Air.....	35
The Launching of an Automobile.....	47
Newest Automotive Ideas.....	64
The Two-Bladed Airplane Fun for Automobile Engines.....	72
Driving a Passenger Car with Wind.....	72
Standardized Bodies for Motor-Trucks.....	72
His Dream of a Noiseless Engine Came True.....	73
House-Making by Motor-Truck.....	75
Running the Factory with Tractors.....	63

NATURAL SCIENCE

Why I Know that Monkeys Talk.....	21
Where Does Our Timber Grow?.....	24
Under the Livermore Tomb.....	26
How to Grow Tish.....	26
This Poor Fish Has No Tail.....	47
Dramatizing Geography.....	50
Taking the Stars' Pictures.....	51
Build a More Bird-House.....	55
The Secret of the Great Bell.....	55
What a Home for Pigeons.....	58
Electrical Slaves of Whistle and Lamp.....	69
Spare the Seed and Spoil the Flax.....	74
Milking the Peanut.....	74
Trying Out the Seeds.....	75
It's Midsummer on Mars.....	76
Fumigating Sick Trees.....	81

PICTORIAL PAGES

Behind the Scenes in a "Movie" Set.....	30
Working Without the Typesetter.....	31
Contrasts—But Not for Money.....	42
Could You Be a Motorman?.....	43
The X-Ray in Manufacture.....	48
"The Man that Hath No Music in Himself".....	52
Giving Big Ben a Bath.....	53
When the Good Old Days Go Good.....	70
Things New for All the Household.....	78
Do It with Tools and Machines.....	79

SHIPS AND SHIPPING

The Coming Triumph of the Motor-Ship.....	29
Making Ships of Puffed Brick.....	37
Trying Out Our Navy's Lines.....	44
Will She Take Home the American's Cup?.....	54
Upside Down to the Dry-Dock.....	61
Machining a Monster Propeller.....	66
Carrying a Monster Gun Under the Sea.....	76
Sunken Ships Luffed with Air-Bags.....	76

SPORTS AND PASTIMES

As an Actor He Is a Bear.....	28
They Can't Pull for the Shore.....	26
A Bear of a Bear Fondles Teddy.....	22
You Would Probably Be Arrested for This.....	46
Music on Electric Anvils.....	48
He Shoots His Toy Airplane from a Gun.....	25
Outdoor Moving-Picture Shows.....	62

MISCELLANY

A Liberty Month and a Nameless Day.....	25
Protecting the Ranger's Eyes.....	25
Where House Numbers Grow on Sidewalks.....	26
Momentaries of Two Wars in Its Side.....	26
Would You Like Your Spats Hand-Painted?.....	27
And Then Again, There Are Funny Ones.....	27
A Monument to Four Race Horses.....	27
No Way to Treat a Perfect Lady.....	28
The Skyrocket Chicken Farm.....	32
Watch Out for Flour and Starch.....	38
Hit Your Rubbers to Your Shoes.....	38
Blindfolded by Clear Glasses.....	40
Check Your Hat, Sir?.....	44
Buy Yourself an Ink-Slick.....	45
Use a Put to Heat Your Flap.....	47
Battery Chickens in a Canadian Garden.....	47
Is This Water a Waste?.....	51
Over-Exposed Blueprints.....	51
The Capital Gets a Bath.....	54
What Is Wood Alcohol?.....	54
Silk Stockings for the Garden.....	56
The Sword of Pershing.....	56
They Will Be the Biggest Guns Afloat.....	56
The "Ad" of a Thousand Diamonds.....	57
Awake to the Sound of Sweet Music.....	59

(Continued on page 6)

CHICAGO TECHNICAL COLLEGE

431 Chicago "Tech" Building, Chicago

Without obligation upon me, send your Catalog on subject enclosed below. Also FREE Lesson, if inquiry is an Drafting or Plan Reading.

- Mark X opposite work in which you are especially interested
- ☐ Architectural Drafting
 - ☐ Machine Drafting
 - ☐ Electrical Drafting
 - ☐ Structural Drafting
 - ☐ Sheet Metal Drafting
 - ☐ Builders' Course
 - ☐ Plan-Reading—Buildings
 - ☐ Plan-Reading—Ship Men
 - ☐ Estimating
 - ☐ Surveying
 - ☐ Aeromobiles
 - ☐ Auto and Gas Engines

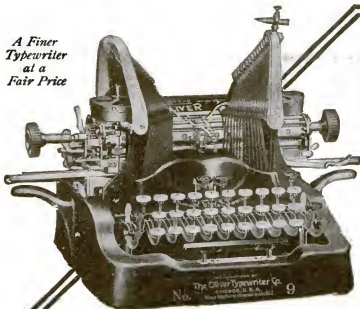
Name.....

Address.....

City.....State.....

College or Home Study? State which.....

A Finer
Typewriter
at a
Fair Price



\$\$

3

A
Month

Pays
for

Latest and Finest New Oliver

A year and a half to pay! Only \$3 a month. Payments so small as to average only about ten cents a day. That is our easy payment plan on the Oliver. And you have the use of the typewriter while you are paying for it. You may now order direct from the Oliver Typewriter Company and get the latest model Oliver at a saving of \$43 and on payments so easy that you won't miss the money.

Only \$57 for the \$100 Oliver

A full saving to you of \$43 on the famous Oliver No. 9—our latest and newest model. That is what our new selling plan makes possible. During the war we learned many lessons. We found that it was unnecessary to have such

a vast number of traveling salesmen and so many expensive branch houses. We were able to discontinue many other superfluous sales methods. As a result, \$57 now buys the identical Oliver formerly priced at \$100.

Try It Free—Send No Money

Not a cent in advance. No deposit of any kind. No obligation to buy. The coupon is all you need send. The Oliver comes to you at our risk for five days free trial in your own home.

Decide for yourself whether you want to buy or not.

If you don't want to keep the Oliver, simply send it back at our expense. If you do agree that it is the finest typewriter, regardless of price, and want to keep it, take a year and a half to pay at the easy rate of only \$3 a month.

Only the Coupon!

No pre-payment required. This is a real free trial offer. All at our expense and risk. Fill out and mail the coupon and get the Oliver for free trial. If you should wish further information before requesting a free trial, mark the coupon for the free books mentioned therein. Clip and mail the coupon now.

Canadian Price, \$72

The Oliver Typewriter Company
1104 Oliver Typewriter Bldg. Chicago, Ill.

309-02

THE OLIVER TYPEWRITER COMPANY

1104 Oliver Typewriter Bldg., Chicago, Ill.

☐ Ship me a new Oliver Nine for five days free inspection. If I keep it, I will pay for it at the rate of \$3 per month. The title to remain in you until fully paid for.

☐ My shipping point is..... This does not place me under any obligation to buy. If I choose to return the Oliver, I will ship it back at your expense at the end of five days.

☐ Do not send a machine until I order it. Mail me your book "The High Cost of Typewriters—The Reason and the Remedy," your de luxe catalog and further information.

Name

Street Address

City.....State.....

Occupation or Business.....

TO SOFTEN YOUR BEARD

To Shave Easier, Quicker, Better

Shavaid, a new scientific preparation, will make your daily shave a pleasure. It softens the beard instantly, soothes the skin. No rubbing in. No hot water. Give Shavaid *one trial* and you will be convinced. Mail the coupon for your Free Trial Tube.

HOME shaving is being revolutionized by this new way of softening the beard. Men the nation over are welcoming this valuable preparation. It means an easier, quicker, more comfortable shave. Shavaid, applied to the dry beard, softens it instantly. It makes the razor "take hold." It does away with all "pull." Shavaid soothes the tender skin.

Harsh Methods Unnecessary

Hot water draws the blood to the surface. Rubbing in makes the face tender. Both open the pores. Neither is necessary.

Harsh methods of shaving age the skin prematurely and cause wrinkles. They make the skin unnaturally dry. After-shaving lotions and creams will not repair the injury thus done. The cause must be eliminated. Shavaid accomplishes instantly what old methods failed to do.

Keeps Skin Healthy

Simply apply a thin coating of Shavaid to the dry beard. Then apply your favorite lather. Shavaid works better if the lather is *not* rubbed in.

Note the cooling, soothing sensation. The lather stays moist and creamy. You will notice how the razor "takes hold," how smoothly and easily it removes the beard.

Men who like a close shave will find Shavaid a revelation. Shave as close as you like, the old drawn, burning sensation is gone. Shavaid makes your face feel cool and comfortable.

The daily use of Shavaid will keep your skin smooth and firm, free from the tenderness and excessive dryness which are caused by hot water and rubbing in. Minor skin eruptions and abrasions yield quickly to Shavaid's soothing, healing influence.

Try It Yourself

Many men are now using Shavaid. Those who shave once with it are convinced of its merits. It is certainly worth trying—free of all cost.

Write your name and address on this coupon. Send it in. Then you can see for yourself what Shavaid will do

toward giving you an easier, quicker, more comfortable shave.

After you have proved to your own satisfaction that you need Shavaid, you can secure it from your druggist at 50c. a tube. If he cannot supply you, we will be pleased to fill your order direct.

Shavaid

Softens the beard instantly

—apply to dry face before the lather.

Saves time and trouble

—no hot water, no "rubbing in" of the lather.

Protects the face

—skin remains firm and smooth.

Removes the razor "pull"

—harsh ways age the skin prematurely.

Replaces after-lotions

—Shavaid is a cooling, soothing balm.

B&B
Shavaid

At Druggists—50c. a Tube

BAUER & BLACK, Chicago, New York, Toronto

Makers of Sterile Surgical Dressings and Allied Products



BAUER & BLACK, Chicago, Ill.

Mail free trial tube of Shavaid to

Name.....

Street Address.....

City..... State.....

Drawing Outfit and Drawing Table

FREE



SIZE
20x25
INCH



Special Offer to BUILDERS

Yes, I will give you this complete drawing outfit absolutely free. The instruments are in a handsome high class, plush lined folding case. They are regular draftsman's working instruments. Besides I will give you absolutely free, a 20x25 inch drawing board, a 24 inch T square, a 12 inch rule, a supply of drawing paper, two triangles, a French curve, pencils, erasers, thumb tacks, etc.

Delivered at Once

The drawing table is the "Chief's Own" adjustable folding Drawing Table, same as used and needed by first-class draftsmen. The complete outfit and table are delivered to you at once. You have them to work with from the very first day.

Be a Draftsman Draw \$250⁰⁰ to \$300⁰⁰ Per Month

There is an urgent demand for skilled draftsmen. Companies are issuing calls every day for men to fill positions paying from \$250.00 to \$300.00 per month. Builders are peculiarly fitted to make big successes as expert draftsmen. Send the coupon now.

Chief Draftsman Will Instruct You Personally

I am Chief Draftsman of a large and well known firm. I know just the kind of training that is demanded from men who get big salaries. I want to train a limited number of builders to take big paying drafting positions. I train you by giving you actual practical work, the kind that

you must be able to do to hold permanent, high salaried jobs. I give you my individual instructions. If your work is right, I will advance you rapidly. If it is wrong, I will show you where and make you do it right, and do all I can to make you an expert draftsman and designer in a short time.

Pay as You Wish

What I want is the right kind of men. Don't bother about expense. I will give you the working outfit free if you get in at once. I charge a very small fee for training you to be an experienced draftsman. You can pay the small cost as suits you best.

Send Coupon for My Big New Book

Put your name and address on the coupon and send it to me today. I will send you my new book "Successful Draftsmanship," and the great special offer that I am now making on which you get the complete Draftsman's Working Outfit and Drawing Table absolutely free. You assume no obligations of any kind in sending coupon. Get in line for a big paying position. Getting the book and full particulars of the special offer is the first step.

Chief Draftsman Dobe Engineers' Equipment Co., Inc.
Division 1364 CHICAGO, ILL.

Chief Draftsman Dobe, Engineers' Equipment Co., Inc.
Dept. 1364 Chicago, Illinois

Without any obligations on me whatsoever, please mail your book, "Successful Draftsmanship," and full particulars of your liberal "Personal Instruction" offer to Builders. It is understood that I am obligated in no way whatever.

Name.....

Address.....

Post Office.....State.....

21 Ruby and Sapphire Jewels
Adjusted to the Second
Adjusted to Temperature
Adjusted to Isochronism
Adjusted to Positions
25-Year Gold Strata Case
Genuine Montgomery Railroad Dial
New Ideas in Thin Cases

Look!

Only **\$3.50**
a Month



The Burlington

The Watchmakers' Masterpiece

JUST think of it! Only \$3.50 per month—a great reduction in watch prices direct to you—a 21 jewel adjusted watch at rock-bottom price. Indeed, the days of exorbitant watch prices have passed.

See It First

You don't pay a cent to anybody until you see the watch. You don't buy a Burlington Watch without seeing it. Look at the splendid beauty of the watch itself. Thin model, handsomely shaped—aristocratic in every line. Then look at the works! These you will see the masterpiece of the watch maker's skill. A perfect time-piece adjusted to positions, temperature and isochronism.

Practically every vessel in the U. S. Navy has many Burlington watches aboard. Some have over 100 Burlingtons. The victory of the Burlington among the men in the U. S. Navy is testimony to Burlington superiority.

Send Your Name on This Free Coupon

Get the Burlington Watch Book by sending this coupon now. You will know a lot more about watch buying when you read it. You will be able to "steer clear" of the over-priced watches which are no better. Send the coupon today for the watch book and our offer.

Burlington Watch Co.
19th St. and Marshall Blvd.
Dept. 1364 Chicago, Illinois

Canadian Office:
355 Pargue Ave., Winnipeg, Man.

Burlington Watch Co.
19th St. and Marshall Blvd.
Dept. 1364 Chicago, Ill.

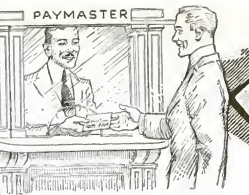
Please send me (without obligation and prepaid) your free book on watches with full explanation of your cash or \$3.50 a month offer on the Burlington.

Name

Address



PAYMASTER



Five Days to Prove I Can Raise Your Pay

I've done it for thousands of others. I can doubtless do it for you. If I can't then it won't cost you a cent

I MEAN just what I say. There's no trick or catch to it. Give me five days and I'll prove that I can get your pay raised for you. I'll do it on a "show you" basis. You get the proof before you pay me a cent.

You've probably heard of me. My name is Pelton. Lots of people call me "The Man Who Makes Men Rich." I don't deny it. I've done it for thousands of people—lifted them up from poverty to riches. There's no sound reason why I cannot do it for you. So let's try.

Now, follow me carefully. I'm going to tell you exactly how to do it. I'm in the possession of a "secret" for which men have been searching since Time began.

There's no need to discuss the whys and the wherefores of this "secret." Suffice it to say that *It Works*. That's all we care about—*It Works*. Over 400,000 men and women the world over have proved it for themselves.

A FEW EXAMPLES

Personal Experiences

Among over 400,000 users of "Power of Will" are such men as Judge Ben B. Lindsay, Supreme Court Justice Parker, Wu Ting Fang, Ex-U. S. Chinese Ambassador; Assistant Postmaster General Britt; Governor McKelvie of Nebraska; General Madison C. Christie of Wells-Fargo Express Co.; E. H. Illing Lewis of Detroit; Gov. Ferris of Michigan; E. T. Meredith, Sec'y of Agriculture and many others of equal prominence.

\$300 Paid from One Day's Reading

"The result from one day's study netted me \$300 each. I think it a great boot and would be without it for ten times the cost."—Col. S. W. Wilkie, Roscoe, So. Dakota.

Worth \$15,000 and More

"The book has been worth more than \$15,000 to me."—Oscar B. Thompson.

Would Be Worth \$100,000

"If I had only had it when I was 20 years old, I would be worth \$100,000 today. It is a book a hundred times the price."—S. W. Taylor, The Santa Fe Ry., Milam, Tex.

From \$100 to \$3,000 a Month

"One of our boys who read 'Power of Will' before he came over here jumped from \$100 a month to \$3,000 the first month, and won a \$200 prize for the best, among ships in the state."—Private Leslie A. Still, A. E. F. France.

Among them are such men as Judge Ben B. Lindsay; Supreme Court Justice Parker; Governor McKelvie of Nebraska; Wu Ting Fang, Ex-U. S. Chinese Ambassador; Governor Ferris of Michigan; E. T. Meredith, Sec'y of Agriculture and thousands of others of equal prominence.

Some of the things this "secret" has done for people are astounding. I would hardly believe them if I hadn't seen them with my own eyes. Adding ten, twenty, thirty or forty dollars a week to a man's income is a mere nothing. That's merely playing at it. Listen to this:

A young man in the East had an article for which there was a nation-wide demand. For twelve years he "puttered around" with it—

barely eking out a living. To-day this young man is worth \$200,000. He is building a \$25,000 home—and paying cash for it. He has three automobiles. His children go to private schools. He goes hunting, fishing, traveling, whenever the mood strikes him. His income is over a thousand dollar a week.

In a little town in New York lives a man who two years ago was pitied by all who knew him. From the time he was 14 he had worked and slaved—and at sixty he was looked upon as a failure. Without work, in debt to his charitable friends, with an invalid son to support, the outlook was pitchy black. Then he learned the "secret." In two weeks he was in business for himself. In three months his plant was working night and day to fill orders. During 1916 the profits were \$20,000. During 1917 the profits ran close to \$40,000. And this genial 64-year-old man is enjoying pleasures and comforts he little dreamed would ever be his.

I could tell you thousands of similar instances. But there's no need to do this as I'm willing to tell you the "secret" itself. Then you can put it to work and see what it will do for you. I don't claim I can make you rich over night. Maybe I can—maybe I can't. Sometimes I have failures—everyone has. But I do claim that I can help go out of every 100 people if they will let me.

The point of it all, my friend, is that you are using only about one-tenth of that wonderful brain of yours. That's why you haven't won greater success. Throw the unused nine-tenth of your brain into action and you'll be amazed at the almost instantaneous results.

The Will is the motive power of the brain. Without a highly trained inflexible will, a man has about as much chance of attaining success in life as a railway engine has of crossing the continent without steam. The biggest ideas have no value without will-power to "put them over." Yet the will, altho heretofore entirely neglected, can be trained into wonderful power like the brain or memory and by the very same method—intelligent exercise and use.

If you held your arm in a sling for two years, it would become powerless to lift a feather from lack of use. The same is true of the Will—it becomes useless from lack of practice. Because we don't use our Wills—because we continually bow to circumstance—we become unable to assert ourselves. What our wills need is practice. Develop your will-power and money will

flow in on you. Rich opportunities will open up for you. Driving energy you never dreamed you had will manifest itself. You will thrill with a new power—a power that nothing can resist. You'll have an influence over people that you never thought possible. Success—in whatever form you want it—will come as easy as failure came before. And those are only a few of the things the "secret" will do for you. The "secret" is fully explained in the wonderful book "Power of Will."

You Can Prove This At My Expense

I know you'll think that I've claimed a lot. Perhaps you think there must be a catch somewhere. But here is my offer. You can easily make thousands—you can't lose a penny.

Send no money—no, not a cent. Merely clip the coupon and mail it to me. By return mail you'll receive, not a pamphlet, but the whole "secret" told in this wonderful book, "POWER OF WILL." Keep it five days. Look it over in your home. Apply some of its simple teachings. If it doesn't show you how you can increase your income many times over—just as it has for thousands of others—mail the book back. You will be out nothing. But if you do feel that "POWER OF WILL" will do for you what it has done for over four hundred thousand others—if you feel as you do that it's the next greatest book to the Bible—send me only \$3.50 and you and I'll be square.

If you pass this offer by, I'll be out only the small profit on a three and a half-dollar sale. But you—you may easily be out the difference between what you're making now and an income several times as great. So you see you've a lot—a whole lot—more to lose than I.

Mail the coupon or write a letter now—you may never read this offer again.

PELTON PUBLISHING COMPANY

14-H Wilcox Block Meriden, Conn.

PELTON PUBLISHING COMPANY

14-H Wilcox Block, Meriden, Conn.

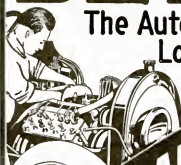
You may send me "Power of Will" at your risk. I agree to remit \$3.50 or remail the book to you in five days.

Name

Address

DETROIT AUTO CENTER

The Auto Center is the Logical Place To



Training for Head and Hand

Auto Factories Endorse School

The Auto Factories here in Detroit—THE HEART OF THE AUTO INDUSTRY—do not hesitate to endorse our school. We have letters from such factories as Packard, Maxwell, Hudson, Chalmers, Hupmobile, King, International Harvester Co., and others, endorsing the school. They employ our graduates and furnish us with their latest chassis for our students' use.

Earn \$100 to \$400 Monthly

Trained men are always needed and can get the big, high-salaried jobs. Trained men are in big demand and we constantly have a greater demand than we can supply—both from Detroit and throughout the country. There are thousands of good locations for garages and the big factories help our graduates get these fine locations. Service stations are after

There were more than seven million cars and trucks licensed in the United States during 1919. Thousands more are being added to this astounding number every day and still the demand is far ahead of production. And Detroit is the Heart of this tremendous industry.

our graduates to fill positions as managers, foremen, etc., at big salaries. Auto owners prefer to put their cars in a competent mechanic's hands and our graduates have no trouble getting business and holding it. Our graduates who are in business make \$5,000 to \$10,000 and more yearly.

Read What the Factories Say of the M. S. A. S.

HUDSON MOTOR CAR COMPANY DETROIT, MICH., U.S.A.

The Michigan State Auto School in our opinion, is the finest institution of its kind in the country. In fact, we endorse its method of instruction. We have recommended a great many students to them and the results were satisfactory. The Michigan State Auto School ranks highest in the standard of schools. Its equipment and personnel is second to none. This school is considered one of the most efficient schools in the country. If you intend to visit any school, then by all means choose the best one. The Michigan State Auto School, so far as we know, is the best. You will make no mistake in enrolling for a course. Yours faithfully,
HUDSON MOTOR CAR COMPANY,
Service Department.



The Michigan State Auto School enjoys a very enviable reputation and is probably one of the best of its kind in the United States. Have no hesitation in recommending it in every particular. Yours truly,
PACKARD MOTOR CAR COMPANY.

MANY TRAIN AT DETROIT AND RETURN TO THE FARM
This is your chance! Come to Detroit, the heart of this great industry. If you don't care to choose in the spare business, private property, adjust and repair your machines yourself—save thousands of dollars in repair bills as well as avoid costly delays at busy seasons. Think, too, of the money you can make in your spare time adjusting and repairing your neighbor's machine, either in a small shop on your own farm or at some conveniently located place nearby.

MONEY-BACK GUARANTEE



Complete Training in Auto Electrics

Our course in Auto Electrics is most complete. Standard electric equipment for Autos, Trucks, and Tractors is in actual operation for students to work on. Students are taught to quickly and easily locate electrical troubles. Hundreds of graduates are filling high salaried positions in electrical service stations. Every quarter of the globe recognizes our school as the world's training place for Auto, Truck, and Tractor Mechanics.

Train in Detroit

Detroit, with its more than 180 Auto, Truck, Tractor and Accessory factories, is the logical place to learn the Auto, Truck and Tractor business; 75% of all automobiles manufactured are made in Michigan—71% of them are made in Detroit alone. Can you think of a better place to learn this business?

Complete Tractor Course Included

You are given complete instruction on care and operation of Farm Tractors in our regular Auto Course. Constantly increasing use of tractors calls for trained tractor men. Manufacturers have placed machines with us to give our students the benefit of practical instruction. Hundreds of students are completing our course and returning to the farm, competent to care for their tractors and the tractors of their neighbors.

Not a One-Man School

This school is founded on the best, newest and most practical principles in the Auto, Truck, and Tractor business. Our course is built on the broadest and closest co-operation of Manufacturers, Garages, Service Stations and Owners.



It is not one man's ideas, but the combined ideas of the biggest and most successful men in each field.

A. C. ZELLER, Pres.

Brazing, Welding and Tire Repairing Taught

These two subjects are taught in separate courses. Hundreds of students take them with the Complete Auto Course. Others take them separately. Competent men are in big demand in both fields. Brazers and welders are needed in every field—Tire Repair men are always in big demand.

Graduates Pass State and City Examinations

Graduates of the M. S. A. S. have no difficulty in passing required examinations for automobile mechanics, chauffeurs, etc. No matter where you go, our training will enable you to handle the work easily and quickly.

Students From All Over the World

Men are coming to our school from every quarter of the globe recognizing it as the world's training place for auto, truck, and tractor mechanics because of the close factory co-operation.

FREE—Big 176 Page Catalog

Send the coupon today for big 176-page catalog and copy of latest "Auto School News" both absolutely FREE. They tell about courses—show more than a hundred pictures of equipment—give letters from big Auto Factories and Graduates. Our courses are reasonably priced—so reasonable in fact that many have jumped on a train and come to Detroit without having stopped to write for catalog. Our Money-Back Guarantee protects you. If you can't come, get the catalog. Resolve to join the business in Detroit—the Heart of the Auto Industry. Use the coupon now.

Open All Year—Start Any Time

Our school is open the year 'round. Enter the classes any day. You can get started the same day you arrive. Our welfare department will assist you in finding a good room and splendid meals.

SEND THIS COUPON TODAY

MICHIGAN STATE AUTO SCHOOL

584 Auto Bldg., 87-89-91 Woodward Ave., DETROIT, MICH.

GENTLEMEN: Please send me, absolutely FREE New 176-page Illustrated Catalog, "Auto School News," and information as checked below.

☐ Auto and Tractor Course
☐ Tire Repairing
☐ Brazing and Welding

(Mark each course you are interested in) or, better still, you can expect me about

Name

Street

City, State

MICHIGAN STATE AUTO SCHOOL

"Most Progressive Auto School in America"—"In the Heart of the Auto Industry"

584 Auto Building
687-89-91 Woodward Ave.

DETROIT, MICH., U.S.A.

PATENT ATTORNEYS

PATENTS. If you have an invention which you wish to protect and you want to know how to obtain protection in regard to the best way of obtaining protection. Please send sketches or a model of your invention and a description of the device, explaining its operation. All communications are strictly confidential. Our vast experience, extending over a period of 30 years, enables us in many cases to advise in regard to patentability without any expense to the client. Our method of securing a patent is simple, and we can obtain a patent as soon as possible. This explains our methods, and it is in regard to Patents. We have secured Patents, etc. Scientific American contains Patents. Notes. Decisions of how to obtain a patent. Patents of recently patented inventions. Munz & Co. 625 F Street, Washington, D. C.; Tower Building, Chicago; Patent Building, 528 Market Street, San Francisco, California.

PATENTS. Herbert Jenson, Patent Attorney and Mechanical Engineer, 622 E. Street, Washington, D. C. 362 University Street, Montreal, Canada.

PATENTS. Trademark, copyright, Charles W. reasonable. Metzger, Washington, D. C.

"INVENTORS' ADVISER" sent free on request. William L. Linton, 101 E. Street, Washington, D. C. 362 University Street, Montreal, Canada.

PATENTS. Booklet free. Highest references. Best results. Thompson, 624 F Street, Washington, D. C.

PATENTS. Free in installments. Frank T. Fuller, formerly Patent Attorney, 101 E. Street, Washington, D. C.

INVENTIONS patented trademark registered: labels, prints, publications copyright: prompt service: reasonable. Plain and simple. J. W. Coleman, 624 F Street, Washington, D. C.

PATENT applications filed on partial payment plan. Trade-marks, copyrights, etc. Milo B. Stevens & Company, 624 F Street, Washington, D. C.

PATENTS. Prompt service. Highest references. Moderate fees. Kimball, Master of Patent Law, 35-E. Loan & Trust Building, Washington, D. C.

LACEY Patent-Secret. "The book the inventor keeps." Free. Lacey, 101 E. Street, Washington, D. C.

PATENTS. Trademark. Copyrights. Prompt, prompt, reliable service. Over 30 years' active practice. Write for terms. Booklet free. Address: E. C. Siggers, 101 E. Street, Washington, D. C.

PATENTS. Trademarks. I offer you prompt, prompt, efficient service. Write for terms. Booklet free. Address: J. W. Coleman, 624 F Street, Washington, D. C.

PROTECT your rights. Write for "Record of Invention" which contains full and complete information of conception of your invention. Prompt personal service. Address: J. W. Coleman, 624 F Street, Washington, D. C.

FREE Book on Patents. Write today for free copy and information. Write for terms. Booklet free. Address: J. W. Coleman, 624 F Street, Washington, D. C.

FREE Book on Patents. Write today for free copy and information. Write for terms. Booklet free. Address: J. W. Coleman, 624 F Street, Washington, D. C.

FREE Book on Patents. Write today for free copy and information. Write for terms. Booklet free. Address: J. W. Coleman, 624 F Street, Washington, D. C.

FREE Book on Patents. Write today for free copy and information. Write for terms. Booklet free. Address: J. W. Coleman, 624 F Street, Washington, D. C.

FREE Book on Patents. Write today for free copy and information. Write for terms. Booklet free. Address: J. W. Coleman, 624 F Street, Washington, D. C.

FREE Book on Patents. Write today for free copy and information. Write for terms. Booklet free. Address: J. W. Coleman, 624 F Street, Washington, D. C.

FREE Book on Patents. Write today for free copy and information. Write for terms. Booklet free. Address: J. W. Coleman, 624 F Street, Washington, D. C.

FREE Book on Patents. Write today for free copy and information. Write for terms. Booklet free. Address: J. W. Coleman, 624 F Street, Washington, D. C.

FREE Book on Patents. Write today for free copy and information. Write for terms. Booklet free. Address: J. W. Coleman, 624 F Street, Washington, D. C.

FREE Book on Patents. Write today for free copy and information. Write for terms. Booklet free. Address: J. W. Coleman, 624 F Street, Washington, D. C.

FREE Book on Patents. Write today for free copy and information. Write for terms. Booklet free. Address: J. W. Coleman, 624 F Street, Washington, D. C.

FREE Book on Patents. Write today for free copy and information. Write for terms. Booklet free. Address: J. W. Coleman, 624 F Street, Washington, D. C.

FREE Book on Patents. Write today for free copy and information. Write for terms. Booklet free. Address: J. W. Coleman, 624 F Street, Washington, D. C.

FREE Book on Patents. Write today for free copy and information. Write for terms. Booklet free. Address: J. W. Coleman, 624 F Street, Washington, D. C.

FREE Book on Patents. Write today for free copy and information. Write for terms. Booklet free. Address: J. W. Coleman, 624 F Street, Washington, D. C.

FREE Book on Patents. Write today for free copy and information. Write for terms. Booklet free. Address: J. W. Coleman, 624 F Street, Washington, D. C.

FREE Book on Patents. Write today for free copy and information. Write for terms. Booklet free. Address: J. W. Coleman, 624 F Street, Washington, D. C.

FREE Book on Patents. Write today for free copy and information. Write for terms. Booklet free. Address: J. W. Coleman, 624 F Street, Washington, D. C.

FREE Book on Patents. Write today for free copy and information. Write for terms. Booklet free. Address: J. W. Coleman, 624 F Street, Washington, D. C.

FREE Book on Patents. Write today for free copy and information. Write for terms. Booklet free. Address: J. W. Coleman, 624 F Street, Washington, D. C.

FREE Book on Patents. Write today for free copy and information. Write for terms. Booklet free. Address: J. W. Coleman, 624 F Street, Washington, D. C.

FREE Book on Patents. Write today for free copy and information. Write for terms. Booklet free. Address: J. W. Coleman, 624 F Street, Washington, D. C.

FREE Book on Patents. Write today for free copy and information. Write for terms. Booklet free. Address: J. W. Coleman, 624 F Street, Washington, D. C.

FREE Book on Patents. Write today for free copy and information. Write for terms. Booklet free. Address: J. W. Coleman, 624 F Street, Washington, D. C.

FREE Book on Patents. Write today for free copy and information. Write for terms. Booklet free. Address: J. W. Coleman, 624 F Street, Washington, D. C.

HELP WANTED

DRAFTSMEN. Designers, Engineers and Experimenters. Send for our Draftsman's Guide, New, Nineteen Years Old. One Dollar Postpaid. Free. Write today, why not now. Guide Publishing Company, North Easton, Massachusetts.

U. S. GOVERNMENT wants thousands men, women, up. Permanent positions. \$1200-\$2000 year. Common experience. Many examinations continue. Send questions free. Write immediately. Franklin Institute, 222 West 30th Street, New York, N. Y.

ANYWHERE handy men can make big money with our up-to-minute genuine good window letters. Slann Street, New York, N. Y.

DETECTIVES make big money. Be one! Excellent opportunities. Write American School of Criminology, New York, N. Y.

BE a Finger Print Expert—\$25 to \$50 a week and more in this new and fascinating profession. Finger print intensely interesting. They are in big demand by banks, police, etc. Get detective training. Write today, why not now. Write today for special limited offer and free. Standard Fingerprinting, 122 West 30th Street, New York, N. Y.

GOVERNMENT positions are desirable. \$1000-\$2000 to start. Let our expert Former Government Examiner prepare you. Write today. American School of Criminology, New York, N. Y.

WE want representatives in every factory. You can easily earn \$10 or \$12 a week by visiting about a hour a day of your spare time. Write A. J. MacKey, Suburban Station, 222 West 30th Street, New York, N. Y.

MEN—Boys—Income Motor Experts. \$40 week. Let our expert Former Government Examiner prepare you. Write today. American School of Criminology, New York, N. Y.

DETECTIVES Earn big money. Travel, unpaid. \$1000-\$2000 to start. Let our expert Former Government Examiner prepare you. Write today. American School of Criminology, New York, N. Y.

WRITE for newspapers and magazines. Big pay. Experience unnecessary. Copyright book free. From Radio City, New York, N. Y.

DETECTIVES earn big money. Travel, unpaid. \$1000-\$2000 to start. Let our expert Former Government Examiner prepare you. Write today. American School of Criminology, New York, N. Y.

RAILWAY Traffic Inspectors. \$1100.00 monthly to start and expenses. Travel free. Unlimited opportunity. Prepare for permanent home study. Write today. American School of Criminology, New York, N. Y.

BE a Detective. Excellent opportunity, good pay. Write today. American School of Criminology, New York, N. Y.

BE a Mirror Expert. \$35.00 a day. spare time home. Write today. American School of Criminology, New York, N. Y.

FIREMEN. Hakenstein. Hagenstein. \$100-\$200. Colored Porters, by railroads everywhere. Experience unnecessary. Write today. American School of Criminology, New York, N. Y.

SILVERING Mirrors—I make the French Plate. Easy to learn. Immense profits, booklet free. Sam Weir, New York, N. Y.

BE a Detective. Would you like to be one? Write today. American School of Criminology, New York, N. Y.

VULCANIZING auto tires growing and profitable business. Write today. American School of Criminology, New York, N. Y.

MEN—Age 17 to 45. Experience unnecessary. Travel, make secret investigations, reports, salaries, expenses. Write today. American School of Criminology, New York, N. Y.

WRITE Photostats. \$50 each. Experience unnecessary. Write today. American School of Criminology, New York, N. Y.

GET on the Stage! Experience unnecessary. Send stamp for instructive booklet. All About Vaudeville. Lathrop, 222 West 30th Street, New York, N. Y.

STOP daily grind! Start silvering mirrors, auto head-lamp lenses, etc. Write today. American School of Criminology, New York, N. Y.

BLUPPRINTS. Write to read. See page 12. No experience necessary. Write today. American School of Criminology, New York, N. Y.

BE a Detective. Would you like to be one? Write today. American School of Criminology, New York, N. Y.

VULCANIZING auto tires growing and profitable business. Write today. American School of Criminology, New York, N. Y.

MEN—Age 17 to 45. Experience unnecessary. Travel, make secret investigations, reports, salaries, expenses. Write today. American School of Criminology, New York, N. Y.

WRITE Photostats. \$50 each. Experience unnecessary. Write today. American School of Criminology, New York, N. Y.

GET on the Stage! Experience unnecessary. Send stamp for instructive booklet. All About Vaudeville. Lathrop, 222 West 30th Street, New York, N. Y.

STOP daily grind! Start silvering mirrors, auto head-lamp lenses, etc. Write today. American School of Criminology, New York, N. Y.

BLUPPRINTS. Write to read. See page 12. No experience necessary. Write today. American School of Criminology, New York, N. Y.

BE a Detective. Would you like to be one? Write today. American School of Criminology, New York, N. Y.

VULCANIZING auto tires growing and profitable business. Write today. American School of Criminology, New York, N. Y.

MEN—Age 17 to 45. Experience unnecessary. Travel, make secret investigations, reports, salaries, expenses. Write today. American School of Criminology, New York, N. Y.

WRITE Photostats. \$50 each. Experience unnecessary. Write today. American School of Criminology, New York, N. Y.

GET on the Stage! Experience unnecessary. Send stamp for instructive booklet. All About Vaudeville. Lathrop, 222 West 30th Street, New York, N. Y.

STOP daily grind! Start silvering mirrors, auto head-lamp lenses, etc. Write today. American School of Criminology, New York, N. Y.

BLUPPRINTS. Write to read. See page 12. No experience necessary. Write today. American School of Criminology, New York, N. Y.

BE a Detective. Would you like to be one? Write today. American School of Criminology, New York, N. Y.

VULCANIZING auto tires growing and profitable business. Write today. American School of Criminology, New York, N. Y.

MEN—Age 17 to 45. Experience unnecessary. Travel, make secret investigations, reports, salaries, expenses. Write today. American School of Criminology, New York, N. Y.

WRITE Photostats. \$50 each. Experience unnecessary. Write today. American School of Criminology, New York, N. Y.

BUILD up your own business. We will manufacture articles in demand, and we will sell them at 50 cents a piece, at 30 cents a piece. We guarantee to teach you how to sell retail, wholesale, and by mail. Write today, why not now. Tremendous profit business, one of our specialties. Write today. American School of Criminology, 27 Court Street, Brooklyn, New York, N. Y.

120% Wages Increase. four times production. He manufacture Patent, Trademark, Copyright, essential. Write today. American School of Criminology, 27 Court Street, Brooklyn, New York, N. Y.

HOME-WORK! Ten valuable articles, instructions for making home-made goods. Write today. American School of Criminology, 27 Court Street, Brooklyn, New York, N. Y.

LEARN Trade—Valuening School—Come to our school and learn to repair tires in 10 to 15 days. Let us teach you. Write today. American School of Criminology, 27 Court Street, Brooklyn, New York, N. Y.

RAISE Silver Foxes! Large profits. Easy to raise. Write today. American School of Criminology, 27 Court Street, Brooklyn, New York, N. Y.

TEN CENT package Men's Compound makes one plant excellent ink. Sample 5 cents. A. D. Metter, 101 E. Street, New York, N. Y.

STUDY Human Nature. Make people like you, get along better, make more money, develop a winning personality, lose weight, etc. Write today. American School of Criminology, 27 Court Street, Brooklyn, New York, N. Y.

USED Correspondence Courses of all kinds sold. Courses bought and sold. Write today. American School of Criminology, 27 Court Street, Brooklyn, New York, N. Y.

YOU can earn \$20 to \$150 a week as an Ad-Ver-Tiser. Experience unnecessary. Particulars for stamp. R. F. Korbler, 101 E. Street, New York, N. Y.

I MADE \$10 a week evenings with a small mail-order business. Free Booklet tells how. 2c postage. All Scott, New York, N. Y.

GET an Automatic Fishbowl and take in \$100 a minute! Invest in a pair of traveling with a carnival. Automatic Fishbowl. Write today. American School of Criminology, 27 Court Street, Brooklyn, New York, N. Y.

MONEY Saved! All kinds of used correspondence courses. Write today. American School of Criminology, 27 Court Street, Brooklyn, New York, N. Y.

BARGAINS—Used correspondence courses, all kinds, for sale. Write today. American School of Criminology, 27 Court Street, Brooklyn, New York, N. Y.

RAISE Flemish Giant and Belgian Hares for \$5.00 and express for all raised from our stock. Contract and terms. Write today. American School of Criminology, 27 Court Street, Brooklyn, New York, N. Y.

"THE VEST POCKET LAWYER"—Here at last—in a single volume—a complete law course—directly applicable to the business man. Write today. American School of Criminology, 27 Court Street, Brooklyn, New York, N. Y.

WANTED! Ambitious workers everywhere to establish efficient business. Independent, make big money. Write today. American School of Criminology, 27 Court Street, Brooklyn, New York, N. Y.

FOR Sale—Divided-paying oil royalties and leases. Address: Perry D. Plain, 222 Jackson Avenue, Wichita, Kansas.

START Business. Practical chemists will supply you with formulas for making and selling. Write today. American School of Criminology, 27 Court Street, Brooklyn, New York, N. Y.

PATENTS Procured—Trade Marks Registered—A complete service. Write today. American School of Criminology, 27 Court Street, Brooklyn, New York, N. Y.

EXPLOIT Chemical will furnish formulas and trade secrets in all lines. Late free. W. L. Cummings, Ph.D., Morton Avenue, New York, N. Y.

VULCANIZING Auto tires growing and profitable business. Write today. American School of Criminology, 27 Court Street, Brooklyn, New York, N. Y.

MEN—Age 17 to 45. Experience unnecessary. Travel, make secret investigations, reports, salaries, expenses. Write today. American School of Criminology, 27 Court Street, Brooklyn, New York, N. Y.

WRITE Photostats. \$50 each. Experience unnecessary. Write today. American School of Criminology, 27 Court Street, Brooklyn, New York, N. Y.

GET on the Stage! Experience unnecessary. Send stamp for instructive booklet. All About Vaudeville. Lathrop, 222 West 30th Street, New York, N. Y.

STOP daily grind! Start silvering mirrors, auto head-lamp lenses, etc. Write today. American School of Criminology, 27 Court Street, Brooklyn, New York, N. Y.

BLUPPRINTS. Write to read. See page 12. No experience necessary. Write today. American School of Criminology, 27 Court Street, Brooklyn, New York, N. Y.

BE a Detective. Would you like to be one? Write today. American School of Criminology, 27 Court Street, Brooklyn, New York, N. Y.

VULCANIZING auto tires growing and profitable business. Write today. American School of Criminology, 27 Court Street, Brooklyn, New York, N. Y.

MEN—Age 17 to 45. Experience unnecessary. Travel, make secret investigations, reports, salaries, expenses. Write today. American School of Criminology, 27 Court Street, Brooklyn, New York, N. Y.

WRITE Photostats. \$50 each. Experience unnecessary. Write today. American School of Criminology, 27 Court Street, Brooklyn, New York, N. Y.

GET on the Stage! Experience unnecessary. Send stamp for instructive booklet. All About Vaudeville. Lathrop, 222 West 30th Street, New York, N. Y.

STOP daily grind! Start silvering mirrors, auto head-lamp lenses, etc. Write today. American School of Criminology, 27 Court Street, Brooklyn, New York, N. Y.

BLUPPRINTS. Write to read. See page 12. No experience necessary. Write today. American School of Criminology, 27 Court Street, Brooklyn, New York, N. Y.

BE a Detective. Would you like to be one? Write today. American School of Criminology, 27 Court Street, Brooklyn, New York, N. Y.

VULCANIZING auto tires growing and profitable business. Write today. American School of Criminology, 27 Court Street, Brooklyn, New York, N. Y.

MEN—Age 17 to 45. Experience unnecessary. Travel, make secret investigations, reports, salaries, expenses. Write today. American School of Criminology, 27 Court Street, Brooklyn, New York, N. Y.

WRITE Photostats. \$50 each. Experience unnecessary. Write today. American School of Criminology, 27 Court Street, Brooklyn, New York, N. Y.

GET on the Stage! Experience unnecessary. Send stamp for instructive booklet. All About Vaudeville. Lathrop, 222 West 30th Street, New York, N. Y.

STOP daily grind! Start silvering mirrors, auto head-lamp lenses, etc. Write today. American School of Criminology, 27 Court Street, Brooklyn, New York, N. Y.

BLUPPRINTS. Write to read. See page 12. No experience necessary. Write today. American School of Criminology, 27 Court Street, Brooklyn, New York, N. Y.

BE a Detective. Would you like to be one? Write today. American School of Criminology, 27 Court Street, Brooklyn, New York, N. Y.

He Earns \$50 a Week Repairing Autos

THOUSANDS of men everywhere are doing the same. Many are getting more than this. Some are opening garages of their own. Why don't you get into the auto game too? Men in other lines with a little mechanical ability have doubled their earnings after getting into the fascinating field of auto construction and repairing. Ten times the number of men now engaged in the business are needed. Fine, big paying jobs are waiting for men who "know" to fill them. Read below and find out how you can fit yourself to hold one of these big, man's size jobs in your spare time, without going away from home at a cost of only 7c a day.

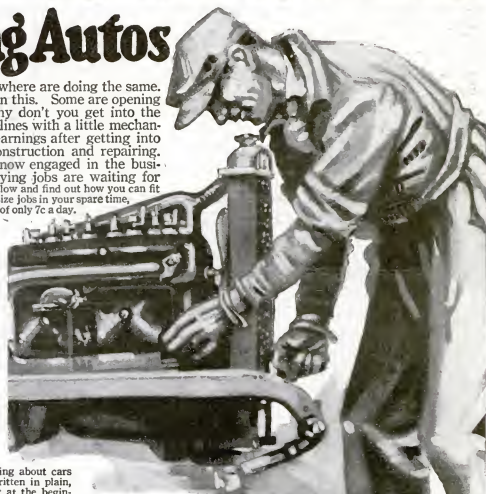
Learn at Home

No need to pay for an expensive course that will take you away from home. You can learn the auto game at a cost of one-tenth the expense of going away to school. You don't have to serve an apprenticeship either. Use spare time only and keep right on with your present work. This Library of Automobile Engineering and Tractor Information will make an expert out of you and fit you for the biggest kind of job. It is in six thick volumes, with 2600 pages and 2300 pictures, plans, diagrams and blueprints, etc. Every part of every well known car is explained. They teach you everything the best auto schools teach.

Fifteen great auto engineers prepared these money-making books for men like you. You don't have to know a thing about cars to understand them. Every page is written in plain, everyday language and they begin right at the beginning. With every set we give FREE a consulting membership in our society. You can write our engineers any time and get their help on any proposition on which you get stuck.

FREE Examination!

Mail the coupon for free examination. Don't send any money. We will ship the books (all 6 volumes) by express collect and you can have a whole week to use them as if they were your own. Give them every test you can think of. Take them to your shop. Show them to your friends and ship them back at your expense if you don't want to keep them. If you do keep the books to help you earn more, send us only \$2.00. You can send the balance of the \$21.80 price the same way—\$2.00 each month. Only 7 cents a day. This is your chance to double your earnings—earn two dollars in the same time it takes to get one now. The coupon is your start. MAIL IT TODAY



Everything About Autos

Automobile Motors; Welding; Motor Construction and Repair; Carburetors and Settings; Valves, Cooling; Lubrication; Flywheels; Clutch; Transmission; Final Drive; Steering; Frames; Tires; Vulcanizing; Ignition; Starting and Lighting Systems; Shop Kinks; Commercial Garage Design and Equipment; Electric; Storage Batteries; Care and Repair of Motorcycles; Commercial Trucks; Gasoline Tractors.

128 Blueprints of Electric Wiring Diagrams

**Don't
Send
Money—
Just
Mail
This
Coupon**

**American Technical
Society :: Chicago**

AMERICAN TECHNICAL SOCIETY Dept. A-204, CHICAGO, U.S.A.

Please send me the 6-volume set of Automobile Engineering for 7 days examination, shipping charges collect. If I decide to buy I will send \$2.00 within 7 days and balance at the rate of \$2.00 a month until \$21.80 has been paid. Then you will send me a receipt showing that the set of books and the Consulting Membership are mine and fully paid for. If I want to get along without the books, I will notify you after 7 days to send for them at your expense.

Name.....

Address.....

City..... State.....

Reference.....

Please Fill Out All Lines



“\$100 a Week, Nell!”

Think What That Means to Us!”

“They’ve made me Superintendent—and doubled my salary! Now we can have the comforts and pleasures we’ve dreamed of—our own home, a maid for you, Nell, and no more worrying about the cost of living!

“The president called me in today and told me. He said he picked me for promotion three months ago when he learned I was studying at home with the International Correspondence Schools. Now my chance has come—and thanks to the I. C. S., I’m ready for it!”

Thousands of men now know the joy of happy, prosperous homes because they let the International Correspondence Schools prepare them in spare hours for bigger work and better pay. You will find them in office., shops, stores, mills, mines, factories, on railroads,—everywhere.

Why don’t you study some one thing and get ready for a real job. at a salary that will give your wife and children the things you would like them to have?

You can do it! Pick the position you want in the work you like best and the I. C. S. will prepare you for it right in your own home, in your spare time—you need not lose a day or a dollar from your present occupation.

Yes, you can do it! More than two million have done it in the last twenty-eight years. More than 100,000 are doing it right now. Without cost, without obligation, find out how you can join them. Mark and mail this coupon!

TEAR OUT HERE INTERNATIONAL CORRESPONDENCE SCHOOLS BOX 7670, SCRANTON, PA.

Explain, without obligating me, how I can qualify for the position, or in the subject, before which I mark X.

☐ ADVERTISING	☐ ELECTRICAL ENGINEER	☐ MECHANICAL ENGINEER
☐ SALESMANSHIP	☐ Electrician	☐ Mechanical Draftsman
☐ TRAFFIC MANAGEMENT	☐ Electric Wiring	☐ Machine Designer
☐ BUSINESS MANAGEMENT	☐ Electric Lighting	☐ Machine Shop Practice
☐ Private Secretary	☐ Electric Car Running	☐ Boilermaker or Designer
☐ Commercial Law	☐ Heavy Electric Traction	☐ Patternmaker
☐ Certified Public Accountant	☐ Electrical Draftsman	☐ Toolmaker
☐ Higher Accounting	☐ Electric Machine Designer	☐ Foundry Work
☐ Railway Accountant	☐ Telegraph Engineer	☐ Blacksmith
☐ BOOKKEEPER	☐ Telephone Work	☐ Sheet Metal Worker
☐ Stenographer and Typist	☐ ARCHITECT	☐ STEAM ENGINEER
☐ Window Trimmer	☐ Architectural Draftsman	☐ Stationary Engineer
☐ Show-Card Writer	☐ Contractor and Builder	☐ MARINE ENGINEER
☐ Sign Painter	☐ Building Foreman	☐ GAS ENGINE OPERATING
☐ CIVIL ENGINEER	☐ Carpenter	☐ Refrigeration Engineer
☐ Railway Mail Clerk	☐ Concrete Build.	☐ Metallurgist or Prospector
☐ Mail Carrier	☐ FURNISH A STEAM PIPER	☐ CIVIL ENGINEER
☐ CARTOONIST	☐ Heating & Ventilation	☐ Surveying and Mapping
☐ Illustrator	☐ Plumbing Inspector	☐ R. R. Constructing
☐ Perspective Drawing	☐ Foreman Plumber	☐ Bridge Engineer
☐ Carpet Designer	☐ CHEMIST	☐ SHIP DRAFTSMAN
☐ Wallpaper Designer	☐ Analytical Chemist	☐ Structural Engineer
☐ Bookcover Designer	☐ Locomotive Engineer	☐ Municipal Engineer
☐ TEACHER	☐ SHIP FOREMAN OR ENGINEER	☐ NAVIGATION
☐ Common School Subjects	☐ Coal Mining	☐ MECHANICAL DRAWING
☐ High School Subjects	☐ Metal Molding	☐ ARCHITECTURE
☐ Mathematics	☐ Assayer	☐ Fruit Growing
☐ AUTOMOBILE OPERATING	☐ TEXTILE OVERSEER OR SUPT.	☐ Vegetable Growing
☐ Automobile Repairing	☐ Cotton Manufacturing	☐ Live Stock & Dairying
☐ Auto, Electrical Work	☐ Woolen Manufacturing	☐ POULTRY RAISING

Name _____

Occupation and Employer _____

Street and No. _____

City _____ State _____

Cigar Economy

THESE days we're looking for *good values*. The smoker is no exception to the rule. He demands good value in every cigar he buys. There's just as much economy in the selection of a cigar as there is in food or clothes or any other commodity.

The White Owl gives you more than good value. You get a good, fragrant, even smoke with each White Owl. In size and appearance—long, with tapering ends—it compares favorably with the more expensive cigars.

But White Owl's greatest value to you is in its curing. A vast stock of high-grade tobacco is constantly being cured by experts for White Owl cigars. White Owl is hand-made. In addition, White Owl is backed by the General Cigar Co., Inc., with its tremendous resources and long experience. This fact alone is a guarantee of good value.

General Cigar Co., Inc.

DEPENDABLE CIGARS

119 West 40th Street, New York City



3 for 25¢ 9¢ for 1



Box of 50
\$4.00

Popular Science Monthly

Waldemar Kaempffert, *Editor*

April, 1920; Volume 96, No. 4
25 Cents a Copy; \$3 a Year



Published in New York City at
225 West Thirty-ninth Street

Why I Know that Monkeys Talk

By R. L. Garner

In the picture at the right, Susie, one of Dr. Garner's subjects, learning to spell. She could assemble three letters of her name, but had no idea of what she was doing



IT matters not to me whether you believe that monkeys talk or not, and it is not the purpose of this article to convince you either way, for convictions are no more a matter of choice than noses are.

The purpose of this article is to present the essential facts thus far tabulated on the subject of simian speech and allow the reader to draw his own conclusions.

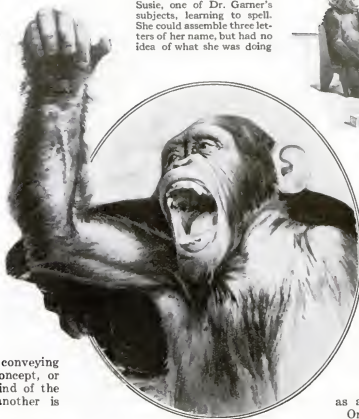
The word *speech* is used throughout as a more exact term than *language*, which is often used in an ambiguous or figurative sense. Let us begin, then, by asking: What is speech?

My reply is:

Any oral sound voluntarily uttered with the definite purpose of conveying a preconceived idea, concept, or impression from the speaker to that of another is speech.

From this plain and simple premise we proceed to collect the salient facts on the question of simian speech and briefly recount how those facts have been formed by many years of methodic research. The limits of space preclude many minor and incidental observations that corroborate the main facts.

All through my early life I observed instances of intercommunication between animals. For some years my studies were only



Susie laughing and threatening to tickle Dr. Garner, who had just tickled her. Her laugh sounds very much like the chuckle of a human being

casual and the results incoherent; but my progress, though slow, was constantly in one direction, for I had faith in my own ability to solve the riddle of speech. In the meantime, I had sorted out certain sounds that appeared to qualify as elements of speech and others that did not. The former were voluntary, more or less modulated, and expressed a desire; while the latter were involuntary or accidental, and expressed no deliberate mental process. The one group I classed as speech sounds and the other as anomalous sounds.

One day I visited the Cincinnati zoological garden, where I saw a large mandrill caged with a lot of small monkeys of three or four different species. The cage was divided into two compartments with a small doorway between them. It was quite evident that the big mandrill was a source of terror to the small monkeys. I noticed that some of them were constantly watching his movements and from time to time uttering peculiar sounds. It was also clear that the sounds conveyed some idea to the

A lifetime of study and nearly a quarter of a century of self-imposed exile in the African jungles in a search for the truth about animal speech are summed up in this article. It was Dr. Garner's last word on the subject to which he devoted his life; for he died at Chattanooga, Tenn., shortly after preparing this manuscript for the POPULAR SCIENCE MONTHLY

small monkeys which inspired them with fear or quieted them, according to the conduct of the mandrill. I spent the whole day watching those animals until I was convinced that they could understand the meaning of the sounds well enough to be guided in their actions by the information conveyed. This incident opened a new avenue of study.

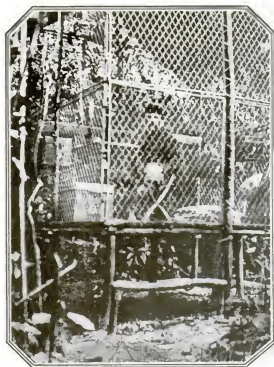
Among the great difficulties in determining the speech of animals, not the least is to distinguish the exact quality or intonation of sounds made by the same animal at different times, to remember the actions that attend them and the results that follow them. It took me a long time to learn that no two species of monkeys had the same vocabulary, and that strange monkeys of different kinds, when first brought together, could not understand each other, though they learned readily.

After countless difficulties, I went to Washington and sought the aid of Dr. Frank Baker. He let me have the use of two monkeys which were kept in a small annex of the Smithsonian Institution. Taking a gramophone to the building, I first placed the two monkeys in different rooms so that neither of them could see or hear the other. Then on the wax cylinder I made a record of the sounds uttered by the male monkey.

This was not difficult, for he was in a loquacious mood. Taking this record into the other room, it was reproduced to the female. She evinced great interest and anxiety. She rushed to the horn, looked into it and all around

the sounds thus reproduced. Dr. Baker was likewise convinced.

After a cursory study of several specimens elsewhere, I selected the brown capuchin monkey because it was one of the most talkative. Incidentally I observed that there were certain sounds that they used more frequently than others. Upon one of these I focused my efforts, and by noting the



Dr. Garner in the cage where he sat motionless for long hours listening to and recording the talk of the jungle folk. The cage was made in twenty-four sections which when assembled made a cube six feet six inches square

actions of the monkeys when uttering or hearing that sound I soon began to make deductions as to its meaning.

The method by which I proceeded is so simple that any novice can follow it. I selected a young capuchin monkey in Central Park and made a clear record

of its voice on a phonograph. In fact, I made several of these, each containing the sound that I regarded as most important. These cylinders were taken to Cincinnati and there reproduced to a specimen of the same kind whose conduct was carefully studied. A second machine recorded the sounds made in response and at the same time the conduct of the second monkey was noted.

Having made a score or so of such records and duly tab-

ulated the actions of the animals at the moment of uttering or of hearing the sounds, I was enabled to carry about with me and study those sounds at leisure, to compare them with others, and ultimately to make a tentative translation of some of them. With those records and data I went to Chicago, where the experiments were continued and amplified. After adding several new cylinders I returned to New York to resume and elaborate the experiments.

By certain manipulations of the phonograph, such as changing speed, reversing the cylinder, and other means, the sounds can be converted into divers forms, analyzed and studied in many aspects. Such experiments show the essential difference between musical notes and spoken sounds, which the keen ear of the monkey perceives more readily than our own ears do.

Now and again a new sound was added to the list and the experiments extended to four or five other species of monkeys. Finally, the chimpanzees in the Cincinnati Gardens confirmed my opinion that the higher types of animals had the higher types of speech, and this fact induced me to go where I could study the gorilla and chimpanzee in a state of nature.

Allotted space here precludes even a synopsis of my seven voyages to tropical Africa, where I have lived most of the time for twenty-seven years, during which I have owned and studied on my premises thirty-nine specimens of those apes, besides a greater number in a wild state.

Living alone in the depths of the great jungle, cut off from all social and intellectual intercourse with my own race, having no companion but an ape which was likewise isolated from his kind, it is surprising how quickly and how well we learned to

How to Talk to a Monkey

It is next to impossible to express animal speech—or even human speech—by symbols, but we asked Dr. Garner to set down as nearly as possible some words from the monkey vocabulary.

Weuh means "What's that?" Said less softly it implies a request
Ki-uh means "I want."
Kri-i? means "Where?"
Ahr-r-r means danger
Qhui expresses want
Ouh-r means "Where are you?"
Eu-nh means "Here"
Khi-iu means "Look out!"
Khi-iu-hou orders a retreat
Chu-h means "Hark!"



Susie in her own kindergarten, where she studied colors, geometrical forms, and numbers. With the bell on the table she would summon her keeper whenever she needed his attention

it, thrust her arm into it, and chattered to it.

Then a record of her voice was made and repeated to the male, who became more excited and vociferous than ever. By repeating and varying these experiments I was convinced that these two monkeys absolutely understood

understand each other. In summing up the results of my researches in the African jungles I would cite the following cogent facts:

The phonograph shows that the higher types of simians have a greater vocal range and a greater number of phonetics, more clearly enunciated, more uniform in quality, and apparently more definite in meaning than have animals of inferior types. Those characters are more marked in the chimpanzee than in any other animal below man.

The next fact in the order of importance is that certain oral sounds of simians are essentially the same in contour and phonetic quality as certain sounds of human speech. Conspicuous among these are the basic sounds of deep "a," as in *war*; short "a," as in *hat*; long "u," as in *blue*; short "u," as in *hut*; short "o," as in *cot*; occasionally long "o," as in *more*; and the diphthong "eu," as in the French *peu*. Every simian does not utter all of these sounds; but the chimpanzee does, and there are other sounds more obscure.

While it is impossible to represent most animal sounds by letters of the alphabet, all of the sounds here cited are capable of being articulated to consonant elements, or vocalized, as it is technically called; and some of these, as uttered by the apes, actually carry in them incipient consonants, such as the initial and vanishing sounds of the semi-vowels "w" and "y," together with perceptible gutturals and labials. These features suggest a transition state in the evolution of speech and warrant the assertion that the phonetics of the ape are about as nearly like those of man as the physical type of the ape is to that of man.

The next item is that certain oral

sounds of simians are recognized by other monkeys of the same kind, and their meaning is sufficiently definite to evoke a uniformity of response that justifies the assumption that those particular sounds have a meaning that serves the purpose of the animal, just as human speech serves that of

sound until a response is elicited; and it is apparent that the speaker is conscious of a definite meaning to the sound he utters, since observation proves that no simian habitually utters those sounds when alone.

The accuracy with which a monkey regulates the loudness, pitch, and quality of tone shows that he is aware of the values of speech sounds as a means of communication; and this fact implies that he possesses both the instinct and the faculty of speech.

It has been shown that all simians recognize and apparently understand the vocal sounds peculiar to their own race when those sounds are imitated by the phonograph and other mechanical agencies. These facts show that the sound alone is the medium of conveying the concept.

The vocabulary of every race of animals is measured by its actual, normal need. It consists of a few single sounds of categoric meaning, which are not qualified by any auxiliary terms or united into sentences. The paucity of words does not lessen their reality as speech. A word is the smallest unit of expression, but it is speech—just as a single drop of water is as real water as a tubful.

All data focus upon the conclusion that every simian has the faculty of speech sufficiently developed to express any desire, need, or mental process as clearly as he is capable of conceiving it.

It is believed that man himself is evolved from a simian prototype. Why may not his speech likewise be evolved from the same source? If, as my research shows, the sounds uttered by simians perform the same functions in simian economy as human speech does for man, in what respect is it not speech?



Susie had just had her photograph taken by flashlight. She didn't like it and was disinclined to face the machine again, but Dr. Garner told her in her own language that it was all right, and you can see by Susie's expression that she was going to take his word for it although still rather anxious

man; that the same sound usually produces the same effect upon those that hear it, and that certain other sounds uniformly produce certain other effects upon them.

Note also the fact that the sounds are habitually addressed to some particular individual or group, with the evident purpose of evoking a response from the object addressed, as must be inferred from the speaker repeating the



Jim is aiding the research by making a phonograph record

This is Jim's expression after listening to his own record

Jim listening critically to the sound of his own voice



Trainloads of great logs are constantly being shipped from Washington and Oregon to mills throughout the country; one fourth of all our timber grows in these states

Where Does Our Timber Grow?

THROUGH all the years that our country has been growing, the trees in the great timber tracts of Washington and Oregon have been growing, too. The supply has, therefore, become so enormous that it will last us for two hundred years even if the usual amount of three hundred million feet is cut each year.

Above is shown a trainload of great, heavy logs leaving home for mills throughout the country. If all the trees in the states of Washington and Oregon were cut and shipped in freight-cars like these, nearly two hundred million cars would be needed for the job.

It is estimated that one fourth of all the timber that is produced in the United States grows in these two states.

Uncle Sam in the Glass Business

A CHUNK of glass twenty inches thick and weighing half a ton, yet perfectly transparent—this is the achievement of the Bureau of Standards after three and a half years of experiment. The glass is fresh from the melting-pot and ready to be made into lenses.

Until recently most of the optical glass used in this country was imported from Germany, but the war forced America into the business, and the final result is an optical glass superior in transparency to the imported product.

Glass for lenses must be without blemish.

The material used consists chiefly of white sand, which is melted down in a porcelain pot and for twenty hours must be stirred with a porcelain rod. The rod must not bump the pot once during the process, for if it does, tiny splinters called "stones" are likely to flake off. Or if the material is stirred too rapidly, glass containing bubbles will result.

Purity of raw material is also essential. The presence of even three hundredths of one per cent of iron will give the glass a greenish hue.



Not a cake of ice, but a cake of glass. It is twenty inches thick and weighs half a ton

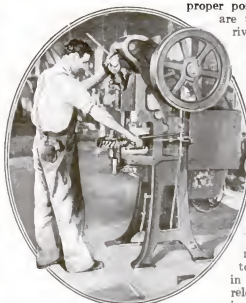
Heat and Hand Rivets by Electricity

WORM wheels of differential gears are not, as a rule, solid, but consist of a bronze rim in which the gear is cut, with two cast-iron flanges fitting into counterbored recesses, one being on each side of the rim.

These flanges, which form the body and the hub of the wheel, are riveted to the rim. A machine recently developed by a manufacturer of riveting-machines in Ohio greatly simplifies the riveting operation, with a corresponding saving in time.

The worm wheel to be riveted is placed on a pin supported by a strong bracket. By turning the wheel on the center pin each rivet is brought in position for being headed. After the wheel has been placed in the proper position the electrodes are then applied to the rivets.

The pressing of a push-button in one of the levers sends an electric current through the rivet, heating it in a few moments. After the rivet is hot enough the upper electrode is removed from contact with the rivet by raising a lever. A spring pulls back the electrode, making room for the heading tool, which is put in action by a foot release. Rivets ranging from $\frac{1}{4}$ to $\frac{3}{8}$ inch in diameter may be headed by this machine.



By moving two levers the first rivet of the worm wheel is placed in position for riveting. Pressure on a push-button turns on the electric current

How the Air in Deep Mines Is Cooled

THE temperature of rocks in deep mines becomes about four degrees warmer with every 1,000-foot drop. To disseminate dust in the Johannesburg mines the rocky sides are wetted.

The air, chiefly through compression, reaches a temperature of about 100° F. at the bottom of the 7,000-foot level, and by evaporation of the water becomes very humid. Fans blowing 400,000 cubic feet of air a minute are used to draw out the warm air and cool to 75° F. the deepest pits.

The moisture condenses in a fog in the upper levels of the mine.

A Liberty Month and a Nameless Day

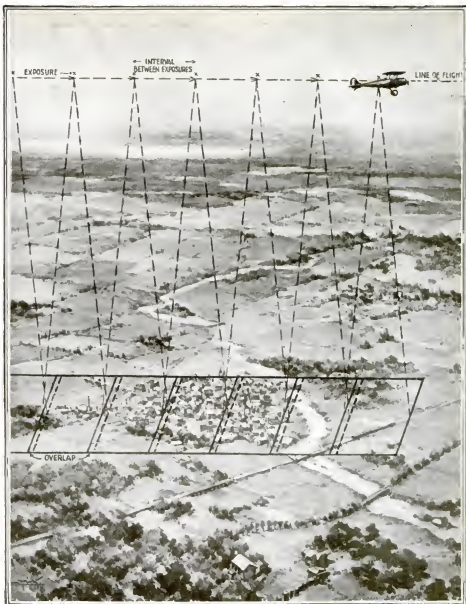
SOME tidy minds fret under the injustice that gives twenty-eight days to February and thirty-one to March, skimping April with thirty. It sets these sensitive minds on edge that the first of the month may fall on Monday, Tuesday, or any other day.

These people may like the proposed "Liberty" calendar. It gives each month just twenty-eight days. Each month begins neatly on a Monday morning and ends as neatly on a Sunday night. But, since twelve months of twenty-eight days leave twenty-nine days to spare, an extra month, called "Liberty" month, is to be slipped in between February and March.

And still there is one odd day to be taken care of; so that becomes an "independent holiday" between December and January, and is affectionately referred to as "Correction Day." Then every four years another nameless day must be slipped in to take care of leap year—proving that the solar system cannot be tamed by logic.

Mon	Tues	Wed	Thur	Fri	Sat	Sun
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28

As an exactly squared up week it looks perfect; but twelve months of such weeks leave twenty-nine days over



© Illustrated London News

Surveying can now be done by airplane; the pilot keeps his airplane perfectly level and at regular intervals snaps pictures which are later assembled

Protecting Rangers' Eyes

"I AM too much in the sun," said Hamlet—and the same thing applies to rangers stationed in Forest Service lookouts. One of them, Walter Jones, of the Siskiyou National Forest in Oregon, has devised an eye-protector.

It is made of cardboard, painted black, is long and narrow, and fits closely around the eyes. Thus the light reaches the eyes through a narrow slot. Rangers must always be on the lookout for forest fires.

If you have ever taken a walk in the country when the ground was covered with snow and the sun was shining on it, you will remember how your eyes ached from the glare. This is similar to the glare in the atmosphere on the mountain-tops.

Trying out the new eye-protector used by rangers; it is made of blackened cardboard



The Air Pilot Now Surveys the Land and Photographs It for Maps

EVEN the bravest surveyors dare not enter some places, and these are now being surveyed by airplane.

The pilot keeps his airplane in a horizontal position, and snaps pictures of the land below at regular intervals. He travels backwards and forwards, taking pictures until he has covered a large section of the land. These pictures are afterward developed and pasted together to form a photographic map.

The pilot's first job is to keep his camera perfectly horizontal; this he does by means of a spirit-level placed on top of it. Then, when he snaps the pictures, he does so at regular short intervals, so that successive pictures just overlap. The speed of the airplane, its height, and several other factors must be taken into consideration when determining the time-interval between exposures. A newly invented instrument figures out these intervals.

Under the Liverwurst Tree

GERMANY sends us this picture of the "liverwurst" tree. The fruit of this tree is long, narrow, and looks like sausage. It hangs from the branch just as wursts hang in the show-case of a delicatessen shop.

The tree grows in Africa and answers to the name of *Artocarpus integrifolia*. The large fruit sometimes reaches a length of eighteen inches. The natives eat it with relish.

The wood of the tree has a grain similar to mahogany and is quite valuable.



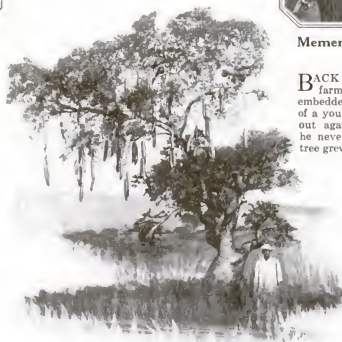
Where House Numbers Grow on Sidewalks

"IS this number 12?" "No; next door."

You've often fumbled this way for a street number on a dark night, wasting lots of time and causing much trouble. House numbers are usually where you can't find them.

But in one of London's suburbs all the house numbers are large ones, made of bright polished metal, and fastened to the sidewalk directly in front of each house. Even a passing taxi driver can read them by the light of his cab. On the sidewalks of the streets on which many people pass, metal arrows are also fastened to remind people to keep to the right.

There is one objection to cluttering up the streets with metal numbers and arrows: you are very apt to stumble over them and fall. Besides, who would polish them and keep them shiny? Surely no modern maid would do such a thing as kneel on the sidewalk and scrub!



Mementoes of Two Wars in Its Side

BACK in Civil War days a farmer who was called to war embedded his scythe in the trunk of a young tree, intending to pull it out again when he returned—but he never returned. As the young tree grew up it gradually swallowed the scythe, until now only six inches of it project from the side.

There are two more scythes in the tree today, placed there by descendants of the Civil War hero, who fought in the Great War. And the villagers added to the collection by placing three American flags in the branches.

In spite of its burden, the tree continues to flourish. It is located at Waterloo, N. Y.

As an Actor He Is a Bear

MOST movie stars are temperamental—it seems to be one of the requirements. And the bear in the picture below is no exception to the rule. For the last half hour the director has been trying to get this bear to put his head in the pail; and the bear has stonily refused to do so.

Says he in bear language: "I've got them all guessing now. I won't put my head in that pail until I feel like it, and no piece of banana will tempt me. It's always a good plan to get balky once in a while—folks are usually more considerate for some time afterward."

There are a large number of animals drawing salaries in the moving-picture business today. In one picture play all of the actors are animals.

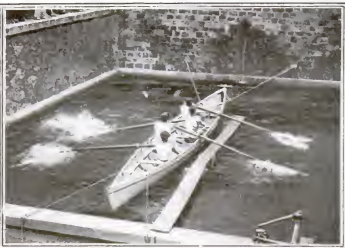


They Can't Pull for the Shore

"PULL for the shore, sailor!"—there's no use singing this song to the sailors shown below. They can't pull for any place, not even for the brick wall in front of them. The reason is that their boat is tied bow and stern, to the sides of the tank in which it floats.

The sailors are students at the Vincennes Military School in France, and they are practising for the racing season. Instructors and fellow students stand on top of the wall and criticize the work of the men in the boat.

The school at Vincennes is much like our West Point Military Academy. The students there are put through a most rigorous course of training, and after they are graduated they become officers in the French army.



Would You Like Your Spats Hand-Painted?

HERE is a girl who wears hand-painted spats, and yet her satin slippers are very ragged at the toes. This seems like a peculiar combination of wealth and poverty, but when you stop to consider it, you realize that a small can of paint is much cheaper than a pair of satin slippers. When passers-by see the flowers on her spats they will never notice what goes on below. And flowers such as these are very easy to paint. Decorations on spats also act as a sort of camouflage for thick ankles. Most people wear spats, not for their beauty, but in order to save the price of a pair of shoes. With spats they can wear last summer's pumps.



And Then Again, There Are Furry Ones

SAYS the owner of the spats below, "I wear fur on them to keep my legs warm." If that is true and she is really anxious to keep warm, we would suggest to her that, instead of wearing short skirts, satin pumps, and spats, she try thick-soled leather boots and longer skirts.

We can't help noticing, too, that she wears white silk stockings. These are not nearly so warm as dark woolen ones. If perchance she doesn't like the looks of woolen stockings—but she should, since they are stylish now—she might retain her silk ones and wear woolen underwear. There are many girls who wrap themselves in great fur coats in winter, while keeping their necks and ankles exposed to the cruel winter blasts.



© International Film Service Co.

A Monument to Four Race-Horses

FOUR famous Derby winners belonging to the late "Lucky Baldwin" are buried at the Santa Anita Rancho, near Los Angeles. And over their grave a giant Maltese cross is being erected by Mr. Baldwin's daughter—the Maltese cross was the racing emblem of the stable.

The cross is six feet square and is made of concrete. It is to be finished in red with black cross-lines. At the base of the cross the names of the horses will appear—"Volante," "Emperor of Norfolk," "Silver Cloud," and "Rey El Santa Anita."

A Truck for the Maid's Use

YOU set out from your room in the hotel to go down to breakfast, leaving the bed unmade, the used towels hanging damply from their hooks, and general disorder. Yet when you return a short time later all is in order. The hotel maid must work rapidly and a combination like the one below will help her greatly.

The carpet-sweeper, broom, duster, and brush are hung on one end and a "soiled-clothes" bag hangs at the other. Bed linen and towels are piled on shelves between.



A Bear of a Bear Fondles Teddy

WHY should your child fondle a Teddy bear? Rather let the bear child do it. But will he? The picture answers the question. But we must admit that he does it growlingly, propelled by the whip in his mistress' hand.

She is Evelyn Greeley, an animal-trainer, and is the only person besides the keeper who can control this particular bear. Perhaps she thinks men's clothes make her look more ferocious. The bear weighs four hundred and fifty pounds. Miss Greeley makes him take on the appearance of a loving and tender bear.

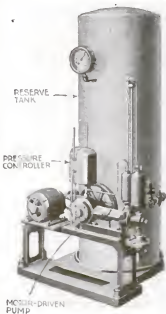


Exit the Old Oaken Bucket

WHEN an automatic pump is properly installed and its motor connected with your electric light circuit, it will draw water from your spring, well, or other source of supply and keep your reserve tank filled whenever water is drawn from it. The pump consumes no electricity when no water is used, and all the attention it requires is the filling of the oil-well about once a year.

The pump here shown is unusually compact. Motor, pump, pressure controller, and the rest of the operating mechanism are mounted on a common base, and cannot therefore get out of alignment.

An idler pulley, actuated by a spring, holds the belt connecting the motor with the belt wheel of the pump at the proper tension. The pump acts as a vacuum pump on the suction stroke and as an air compressor on the discharge stroke. When the tank is filled with water at the proper pressure, the controller automatically stops the pump.



A pumping plant like this will keep your house supplied with water from a spring or well



These are shark-skins being converted into leather; your patent-leather shoes may have belonged to some shark

Do You Wear Shark-Skin Shoes?

WE want to catch sharks as much as sharks want to catch us. Practically all of the shark's body can be converted into commercial products. The skin, for instance, can be manufactured into leather and used in making traveling bags, patent-leather shoes, purses, and such things.

Formerly shark-skin was cleaned and used for polishing, but it wasn't tanned. Now the skins are given a lime bath and the oil pressed out to remove the fishy odor. Every day about seven hundred sharks are caught and sent to a large tannery in Newark, N. J. A twelve-foot shark yields fifty square feet of leather and ten gallons of oil that sells at fifty cents a gallon.

In the Orient some parts of the flesh are used for food. The teeth are made into ornaments by manufacturing jewelers. The scales are turned into glue and the rest of the shark is ground up and used for fertilizer.

The Hardest Tool-Steel Yet Discovered

WHEN a tool becomes dull, time is required to sharpen it, and time in a machine-shop is expensive. A tool that will cut hard materials and still keep its edge saves both time and money. Eleven years ago Professor J. O. Arnold, of Sheffield, England, invented the alloy of steel in which the metal vanadium was introduced to provide a cutting power greater than that of other steels. As a result very rapid production became possible.

He has now produced a steel of even greater cutting power in which the alloy molybdenum replaces the tungsten present in all vanadium-alloy steels, forming six per cent of the steel instead of the eighteen per cent of tungsten. It eclipses the cutting power of all its rivals.

No Way to Treat a Perfect Lady

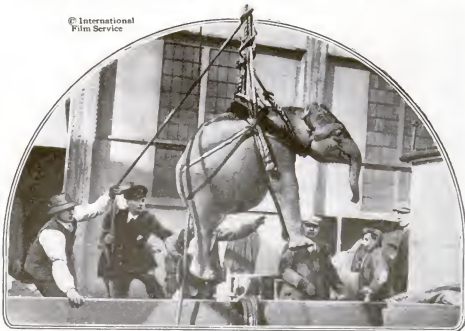
FRIEDA, the elephant, is furious—but she is a perfect lady; and so she shuts her mouth in a thin, firm line, and simply glares. Instead of letting her walk down the gang-plank in dignified fashion, her keepers have tied ropes around her and hoisted her overboard as if she were so much freight.

Frieda and her twin brother Paul,

four years old, have just arrived on the *City of Manila* from India. Along with them came kangaroos, hyenas, and monkeys that will be shipped all over the country.

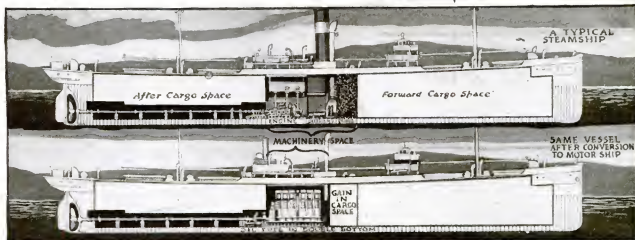
First impressions are important, and we doubt very much that after this experience Frieda will make a patriotic United States citizen.

© International Film Service

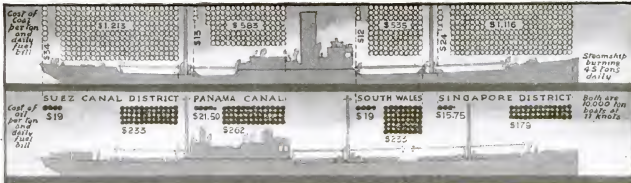


Frieda is furious, and you can't blame her. She was hoisted ashore in a most undignified fashion after a long, hard trip from India to Boston

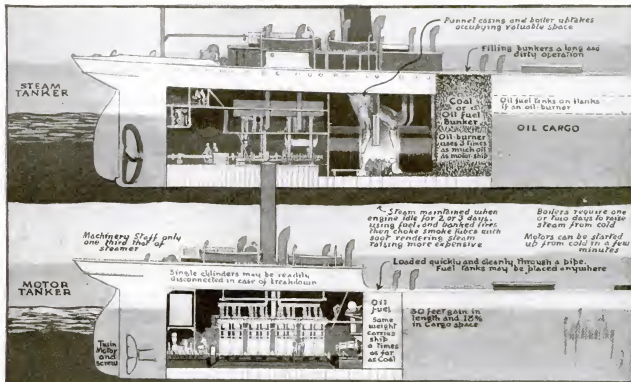
The Coming Triumph of the Motor-Ship



A TYPICAL CONVERSION OF AN OLD STEAMER INTO A MOTOR-SHIP. MANY SUCH CONVERSIONS ARE TAKING PLACE.



THE GREAT FUEL BILL BURDEN OF THE STEAMER AS COMPARED WITH THE MOTOR SHIP ON VARIOUS TRADE ROUTES



THE big battleships of the world are fired with oil fuel. Now the great passenger steamship companies are following suit. But why use boilers at all? Why not consume the oil directly in an engine, just as gasoline is burned in the cylinder of an automobile? Already the motor-ship is here—but only in small sizes.

For merchantmen the present need is to develop the

power of the oil-engine. Today the most powerful units can drive 12,000- or 15,000-ton cargo-ships with twin engines totaling 61,000 horsepower at ten or twelve knots. The oil-turbine appears to be a future possibility. Motor-ships—whose advantages are diagrammed above—are selling at twice the figure given for steamers of like dimensions. Their working, however, costs less than seventy per cent of those of a steamer

Behind the Scenes in a "Movie" Set

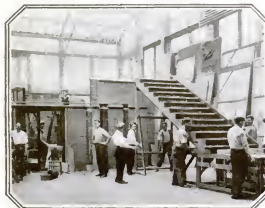
The scenario reads, "Scene on Stairs," and this is what happens in the studio



First, the draftsman draws up plans for the setting. He reads the scenario, and finds that Helene, the heroine, married for money; and, since the staircase scene takes place in her house, the setting must indicate wealth



With clasped hands outstretched in pleading, penitent Helene slowly approaches her wronged husband. And all the while the camera clicks merrily. It is a touching scene, but the directors and the camera-man are too busy to appreciate it



The staircase is shoved over against the wall of the studio, and the rest of the setting is put into place by experienced stage-hands. From the moment Helene starts to descend the stairs, she will have plenty of time to register penitence and display her beautiful negligée

Windows, doors, and staircase are made according to plan in the carpenter shop; they may never be used again, yet they are carefully made and beautifully finished



The painters and paper-hangers paint and decorate until that corner of the studio looks as if it had been transplanted from Fifth Avenue

Tacking decorations over doorways. These small details register wealth—incidentally, also, a decided change from the humble home of Helene's youth

Furnishing Helene's home. This man from the studio has been haunting the furniture houses all day in order to rent appropriate chairs



The stage is set. Now for the lights. A great many scenes are taken indoors and powerful lights are needed for the purpose. While these men put on the finishing touches, so does Helene in her dressing-room upstairs



Doing Without the Typesetter

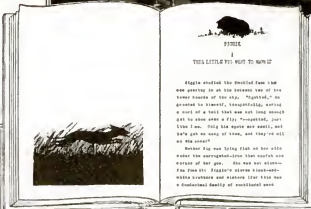
The story of "Piggie"—a typewritten book



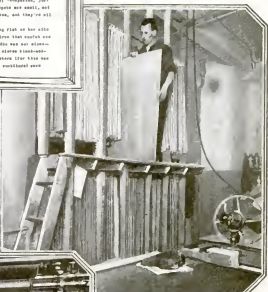
You think she is writing:
"In reply to—" But
you're wrong: it's a book.
When the typesetters in
New York city went on
strike, several magazines
were written by type-
writer, so successfully that
a book called "Piggie" was
done in the same manner



After each page is carefully
typed it is photographed. The
chief objection to these type-
written pages is the ragged edge
at the right-hand side. But
that has been overcome recently



(Right) When the
first edition of
"Piggie" was printed,
the zinc plates
were stored away
for future reference.
As you see, the
dozen or so plates
of "Piggie" were
sandwiched in be-
tween the plates of
many other books



"Piggie" is being put on
the press. The zinc
plates are pliable and fit
perfectly around the top
roller. "Piggie," by the
way, is a fairy story for
grown-ups, and Piggie is
a plain though far from
ordinary pig. The book
is by Eleanor Gates



The printing is done with
a regular press, the zinc
plates or electrotypes of
them being locked in
place in the regular way



Zinc plates are made from the photographs
of the typewritten pages. This man is
making the few necessary corrections on a
thirty-two-page zinc plate. In this kind
of printing the proofreading is done on the
original typewritten sheets by the typist
herself (or possibly himself), and so by the
time the zinc plates are made there is very
little correcting to be done on the plates

Photographs by the Press
Illustrating Service

The Skyscraper Chicken Farm

Raise chickens in the city and save transportation charges



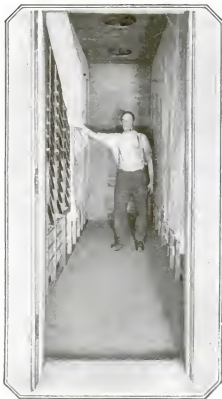
He is putting the new-born babes in boxes and is collecting the shells they left behind them. These young chicks will be brought up indoors under artificial light; for experiments have proved that the source of light makes no difference in the health of chickens

SHOULD the chicken you ate for Sunday dinner return to earth to visit its descendants a century hence, its surprise might not be unlike that which the ghost of Benjamin Franklin would experience if he chanced upon the Woolworth Building.

The chicken house of today is a single-story structure, which, to accommodate the human attendant, is built ten times as high as a chicken requires. Chicken-height floors in an ordinary chicken house would make it a ten-story building; and, once we have the idea of a chicken skyscraper, why not go ahead and make it one hundred stories? "But," says the poultryman, "it isn't natural. A chicken must have contact with the soil, the sunshine, grasshoppers, gentle breezes, and other attributes of nature as it is."

Notwithstanding this objection, the logical place in which to run a future poultry farm will be a building in the city in which the product is to be consumed. There would be the added economies that go with large-scale operation: cheaper building costs, reduced heating expenses, substitution of machine for hand labor. The only added expenses would be artificial light and city ground-rent, which would be offset by the elimination of transportation. Thus more chickens could be raised, more eggs produced, and the price of eggs would then come down from their dollar-a-dozen mark.

These are a few of the striking features of the Hastings factory system of indoor chicken-raising. Milo Hastings, a former government poultryman and an authority on incubator con-



This is one of the incubator rooms, and it holds about fifty thousand eggs. The three bottom trays contain eggs that are nearly hatched. The other trays are placed on collapsible racks so that the eggs can be turned easily



There are thirty thousand eggs in one small room, and they all will be chickens soon. By placing the eggs on shelves that reach from the floor to the ceiling, much space is saved

struction, began his distinctive work in the poultry field by the designing and construction of mechanical draft hatcheries. He conceived the idea of a hatchery with the whole building insulated, and with temperature and ventilation controlled by air drafts forced with blowers. Several plants of this type have been constructed, and the consequent saving in space was enormous, thirty thousand eggs occupying a space scarcely larger than a hall bedroom.

Striking as were the mechanical innovations of these hatcheries, the business enterprise was not propitious, since there were too few poultry plants that had need of a large enough hatching capacity to make advantageous use of such methods. To make his large-scale hatching ideas more feasible, Mr. Hastings next set about to develop an equally perfected system of chick rearing.

The chicken in the egg has only half the attributes

of the living animal. When he kicks aside his protecting shell and starts out in search of worms, his industrial status changes radically. The chicks' needs are instinctively adapted to outdoor life. Thus far poultrymen have thought it cheaper to raise chicks in scattered coops about the fields than to attempt to make the indoor conditions fit those instincts.

Mr. Hastings first set about to learn the efficiency of artificial light. He has raised chickens four different seasons in four different locations with the exclusion of daylight, and has



Carting away the cast-off shells—the result of one day's hatch. The birth-rate is very high in this hatchery, which is located at Petaluma, Cal.

checked these tests against daylight, and against an alternate use of daylight and artificial light. His conclusions are that the nature of the light is unimportant.

With artificial light the relative length of the chick's day and night may be changed or the complete cycle may be shortened, as when the chicks are given alternate periods of light and darkness each of six or eight instead of twelve hours. In like manner the long lighted days of June, if these be accepted as the best for the chick's benefit, may be adopted as the all-year schedule.

But the greatest utility of the artificial light is that it enables the chicks to be placed on superposed floors, at heights adapted to chickens rather than to men, with a result of from five to ten times as many chickens in a building as could be accommodated by the daylight method, and with no restriction of the height, breadth, or length of the building. All building costs and most items of building upkeep become more economical per chicken with the increase in the size of the building.

But, you say, "Such fearful overcrowding would breed disease." Disease is caused by the propagation of germ life. Germs live only in dampness, notably on damp soil or litter, straw, etc. The dryness that can be maintained with artificial heating and blowers, together with steel and concrete construction, and lastly the mechanical circulation, cleaning, and sterilization of the scratching litter, build up a sure defense against disease.

The chick needs exercise and pleasur-

able occupation for its every waking moment. The chicken factory provides artificial means of entertainment and occupation that are as efficient on stormy days and in winter as they are on pleasant days and in sum-

mers themselves, making not only an automatic exerciser, but giving self-cleaning floors. Dust baths, water trickles, and macaroni-like dough worms all aid in the good work.

Machine mixing and feeding give greater accuracy in the proportions of food, and avoid possible negligence of individual employees. A use of artificial light is here discovered in that the chicken will always run from darkness toward light. This fact may be used to lead chickens about the place or encourage them to take long walks through the runways by the manipulation of the switchboard—or, better still, by a modified sign flasher.

The largest hatchery in America is located at Cleveland, Ohio. This plant is equipped with incubators having a capacity of 666,000 eggs—or forty tons—at one time, and in 1918 actually produced and shipped about 1,500,000 chicks in the few weeks that constitute the spring hatching season.

This tremendous business was made possible by the development and perfection of hatching apparatus embodying an entirely new principle of incubation. These incubators are practically automatic in operation and reduce labor to its lowest terms.

Incubators of the ordinary type are boxes or cases of varying form and size, containing egg-trays in one tier and at a uniform level. This arrangement is necessary in order to maintain an even temperature on all parts of the trays. In the new machine the egg-trays are placed in racks, twenty-two tiers high. Uniformity of temperature is obtained by the use of electric fans.

At the Cleveland plant there are twelve of these great incubators, each twelve feet long, ten feet wide, and ten feet high. When filled, each holds 55,500 eggs. With 60 per cent hatches, each turns out 33,000 chicks every three weeks.

In caring for eggs and chicks, the attendant actually enters the incubator. The labor of turning the eggs twice daily is practically eliminated by the arrangement of egg trays in supporting racks. These racks are collapsible, one side dropping down as the other moves up. Merely by pulling down one side of the rack the trays are tipped to an angle of about fifty degrees, throwing the eggs well over on their sides.



Each floor of the chicken skyscraper is sufficiently high to allow the chickens to move about without bumping their heads on the ceiling. Artificial heating dries out the floor dampness that would ordinarily breed disease.

mer. This is achieved with mixtures of litter and grain that are mechanically carried aloft, and, by means of sloping floors, worked along and down by the



This is the alleyway between the incubator rooms of a large hatchery in Cleveland. The women are sorting the eggs that have just arrived. The good ones are put in trays and incubated; the imperfect and cracked ones are sold to local dealers.

A One-Man Street-Cleaning Truck

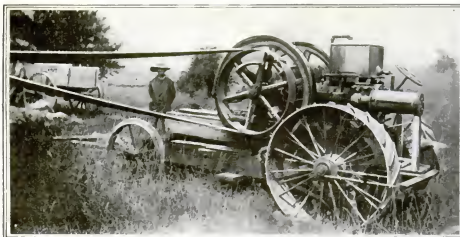
OPERATED by only one man, the improved form of motor street-sweeper shown below sprinkles, sweeps, and collects all manner of street dirt in one operation. The machine is not so wide as to restrict traffic, even on busy streets during the day. Furthermore, it is mounted on solid rubber tires in the rear and pneumatics in front, and is not so noisy as to prevent its use in the residential parts of a city during the night.

The sprinkling equipment consists of a water-supply tank with a capacity of one hundred and fifty gallons and a set of spray nozzles set crosswise under the truck-frame just in back of the front wheels. The water is fed by gravity from the tank at the rear to a bronze gear pump operated from the propelling engine of the apparatus. This pump is under the control of the driver.

After the dirt has been softened by the water, it is left undisturbed until it comes into contact with the broom.

After the dirt has been picked up by the broom, it is conveyed by an entirely new means to the hopper or dirt-container located above the vehicle frame directly in back of the driver's seat.

This new method makes use of an inclined flat steel plate around which are operated a series of rubber squeegees mounted on chains and placed longitudinally of the vehicle center-line. At the top of the steel plate, the dirt drops off into the hopper, while the squeegees snap themselves free from the dirt, pass over the upper chain sprockets, and return for another circuit.



The achieving of a homemade tractor is possible if one happens to own a stationary engine and if there is a junk-yard in the neighborhood

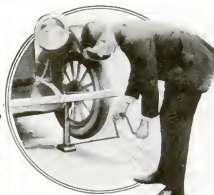
You Can Make a Tractor from a Stationary Farm Engine

THE owner of an eighty-acre farm in Lehigh county, Pa., recently constructed a farm tractor, starting with a fifteen-year-old one-cylinder stationary gasoline engine.

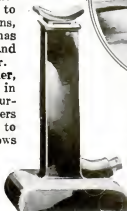
The truck and other parts of the tractor were taken from the scrap-pile. Adding part to part, this mechanical horse soon began to assume definite proportions, and the finished product has all the controls, speeds, and devices of a modern tractor.

Mr. Geissinger, its maker, has been very successful in using it for threshing purposes for himself and farmers in his section. He is able to do plowing with three plows attached to the rear, and it climbs the grades without a balk.

The actual cost of this tractor was \$265.



After the car has been jacked up, the rollers on this jack permit the car and jack to be pushed around to any desired position



The Automobile Jack on Wheels

SO that it can be slid in under the front or rear axle of a car, the latest thing in automobile jacks is mounted on wheels. Wheels are all right for moving the jack into place, but what about holding it in position when the strain to lift the axle is put upon it? Will it slide?

These two very important questions have been answered by the manufacturer; for the wheels are mounted on springs, so that they move up inside of the base of the jack, which then has a firm, non-sliding foundation.

The new jack is further characterized by the fact that it is entirely encased, so that the grease inside the standard cannot soil hands or clothes. A long extension handle, which can be folded to fit into the tool-box, also makes the jack easy to operate.

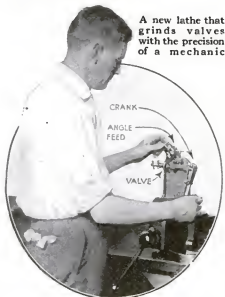


Formerly street-cleaning was a complicated job for three pieces of horse-drawn apparatus. This machine, operated by one man, does it in one third the time

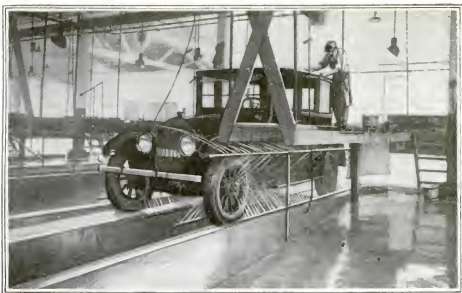
A Simple Lathe Used for Grinding Valves

GRINDING the valves of an automobile engine in an ordinary lathe is a troublesome and expensive job because great care must be taken in centering the valves and this requires the services of an expert mechanic. To overcome these two difficulties, an Indianapolis concern has just devised a simple valve-grinding lathe in which the centering is done automatically by placing the valve stem in the machine.

The apparatus will grind valves with 45-degree or 30-degree heads up to two and one half inches in diameter and with seven-sixteenth-inch stems. All that one need do is to set the cutter for either a 45-degree or a 30-degree head, insert the valve, tighten up on the clamps and feed the valve to the cutter by turning one handle, and revolve the valve about its axis by turning another handle.



A new lathe that grinds valves with the precision of a mechanic



Your car washed while you wait. A spraying apparatus above and at the sides throws water upon all parts of the car at once

Washing Eight Hundred Cars a Day

CLEVELAND has a company that does nothing but wash cars. Its place is open twenty-four hours a day and it washes from fifty to eight hundred cars daily. At any time of the day you can drive your dirty car in one door and within twenty minutes drive it out of another, washed and polished.

After a car has been run on to a set of tracks, the first operation is to clean its sides and under part. This is done by a cradle of perforated pipes at the side and under the car. These pipes have a set of eight sprays, which strike the car from as many different angles, none high enough to splash over the sides and wet the upholstery.

While these sprays are at work softening the dirt, the second operation, that of washing the top, begins.

This is done from one side of the car by a man who stands on a special platform suspended from the roof trusses. From this platform the worker can easily reach the center of the top, which is thoroughly washed with a sponge, the water being provided from an overhead pipe through a flexible hose.

By the time the top is cleaned, the sprays have loosened all the dirt and mud accumulations on the chassis and body, and the car is then moved along the track and the third process is started. This consists of going over the engine hood, body, and tonneau with hose and sponge, and of cleaning the grease from the wheels and chassis with a kerosene spray. The car is then dried by compressed air.

Oil-Tanks Now Filled by Compressed Air

IN garages that have a compressed-air equipment for inflating pneumatic tires, no hoists, inclined skids, or waste of oil in splashing are necessary in filling oil-tanks if the new barrel-discharging bung illustrated herewith is employed. All that is necessary is to insert the bung, attach the air hose, insert the outlet pipe inside the tank, and turn on the air. Furthermore, it is not necessary to lift the barrel off the floor.

The bung is cone-shaped and threaded on the outside. Because it is cone-shaped, it can be made to fit any size of bung-hole by simply screwing it in a trifle farther. It makes an air-tight connection in the barrel. The bung itself is made of metal, and has inserted through it a pipe, the lower end of which is telescoping so as to extend clear to the bottom

of any barrel. The upper end of this pipe extends through the top of the bung and has attached to it a piece of flexible hose several feet long to reach from the bung to the opening in the top of the storage-tank.



By this method the oil is discharged into the service container without collecting foreign matter

The compressed air is led inside of the barrel to be emptied through a hole drilled near the top of the bung and coming out near the bottom. When the air is turned on, it forces the oil up through the telescoping pipe and out through the discharge hose into the tank. Less than five pounds pressure is sufficient to empty an average barrel in a few minutes. If a faster speed of discharge is desired, a greater pressure may be applied without difficulty, inasmuch as there is always an immediate outlet for the oil.



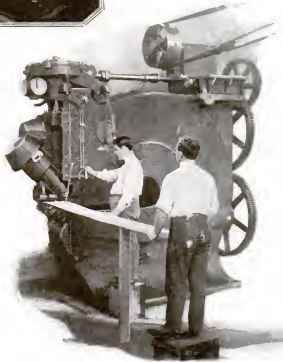
© Press Illustrating Service

Instead of coal put an oil-burner in your range and connect it with a pressure-tank

Making the Coal Stove into an Oil-Burner

SINCE oil is tolerably cheap, change your coal stove into an oil-burner. The picture illustrates how it may be done. The tank is filled with air compressed by a tire-pump. The lower part of the tank contains the oil reservoir. When the valve is opened the compressed air forces the oil through a flexible copper tube into the burner. The oil is blown in the form of a fine spray into the fire-box, where it burns with a hot flame.

The burner is placed on the grate of the fire-box, and the copper feed-pipe is passed through the draft shutter of the ash-box and the bars of the grate and connected with the burner. Whenever the pressure becomes too low, a few strokes of the piston of the tire-pump will send the hand of the pressure-gage to the desired figure.



The operator can tell from the indicator dial which way to shift the plate

Cutting Iron Plates into Ribbons

ROLLED iron or steel plates, as well as sheets of other metals, from the thin sheet-iron used for stovepipes to the heaviest plates of which boilers, tanks, etc., are made, are cut with shears. Formerly straight-edged cutters, operating on the same principle as the two blades of a pair of scissors, were used for that purpose. More recently rotary shears have taken their place.

A heavy steel disk with a sharp cutting edge is rotated against a stationary straight edge of hard steel. The plate to be cut is passed between the rotating cutting disk and the straight edge against which it bears. The disk, which is pressed against the plate with tremendous force, cuts through the metal as the cutter of the trimming wheel used by photographers cuts through the paper of a photographic print.

When long strips are to be cut, the line along which the cut is to be made is marked on the plate with chalk or paint, and the workmen operating the shears must follow the prescribed line very carefully.

The rotary shears shown in the picture are provided with a device that facilitates the task of following the cutting. A line pointer connected with a dial is placed a short distance ahead of the cutter, and the workman stationed at the cutter keeps the point of the instrument on the line.

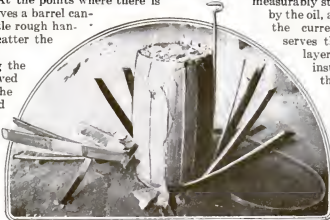
The man who is feeding the plate to the cutter closely watches the indicator dial, which tells him by the position of the hand whenever the cutting line deviates from the plane of the cutting edge in either direction.

Pack the Barrel Tightly

AIR bubbles in a barrel of cement are just as harmful as air bubbles in a jar of preserves. Of course they don't make the cement ferment, but they do collect in the top or at the sides of the barrel as the cement settles down, and makes the barrel weak. At the points where there is nothing but air beneath the staves a barrel cannot withstand a blow. A little rough handling will soon smash it and scatter the cement. What is the remedy?

Thomas Edison, on entering the cement business, quickly solved the problem. Shake down the barrel as you fill it, says he, and the air bubbles will disappear. You have often done the same thing when you filled the flour can.

But barrels filled with cement are too heavy to shake by hand, and so in the Edison plant a machine is used for the purpose. The packers place the barrel on a platform and shake it mechanically.



The cement in the barrel was packed so tightly, to exclude air bubbles, that at the end of a journey it remained firm when the staves were broken away

Finding Oil with Electricity

ELECTRICAL instruments of sufficient sensitiveness can be used to detect the presence of oil-bearing regions when the oil is not far from the surface. In this case the usual current transmitted through the earth is measurably stopped by the insulation afforded by the oil, and the interruption to the flow of the current from metalliferous regions serves thus to indicate the intervening layers of oily material or oil as an insulating medium. But some of the greatest reservoirs of oil exist at such depths that they would be beyond the range of the electrical detector. For deep wells the instrument is then ineffective, but it can be used satisfactorily where the oil is near the earth's surface.

The use of the instrument to detect the presence of metals is well known, but it is the diverted application of the metal-finder that serves now as an oil locator.

Making Ships of Puffed Brick

CONCRETE for ship work must be lighter than the hundred and fifty pound per cubic foot mixture commonly used, if the concrete ship is to compete commercially with wood and steel vessels. Puffed brick is a mixture of cement and other ingredients forming a concrete that is just as strong as the ordinary kind made with cement and crushed stone, but that weighs about one hundred and ten pounds to the cubic foot instead of one hundred and fifty pounds. It is an artificially burned clay or shale uniformly filled with small non-connecting cells.

The basic clay from which it is formed becomes plastic when heated in a kiln to a temperature of between 1,800 and 2,000 degrees, and forms a coating that retains the gases generated by the decomposition of the contained compounds under heat. This expanding gas puffs the brick or the clay ball to several times its original size. While puffed brick is full of holes, it is not porous.

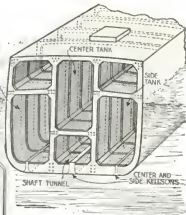
Thus made, the puffed brick is ground to a uniform size and mixed with cement to form concrete, which is poured into the form to mold the shape of the ship in the ordinary manner. Following the latest development in forms for building construction, those forms used for ship work are now generally made of metal and hinged with bolts, so that they can be opened up and moved along as soon as the concrete hardens. After a launching, the forms are replaced, the steel reinforcing rods placed, and the pouring of another ship begun.

One of the latest types of concrete ship in which the

A 7,500-ton oil-tanker is one of the latest concrete ships to be made of puffed brick. Contrary to steel ship practice, its engines and boilers are placed amidships



In building ships of the new puffed brick concrete, the ribs are placed close together, just as in the construction of steel ships



puffed brick concrete has been used is the 7,500-ton oil-tanker a diagram of which appears above. It and its companion ship, a 7,500-ton cargo vessel, are the two largest stone boats that have ever been attempted. The tanker is 420 feet long, and, contrary to conventional steel ship practice, has its 2,800-horsepower reciprocating engines and boilers placed amidships instead of aft. This more desirable location was

chosen because the oil tightness of the shaft tunnel or alley from the rear of the engine to the propeller is more certain when made of concrete than with steel plates.

The system of framing in the tanker is much the same as in steel ships, the frames or ribs being placed close together. Two longitudinal bulkheads extend for the clear length of the vessel from the forward to the aft collision or cofferdam transverse bulkheads.

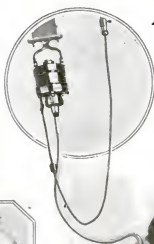
Try a Sample, Lady?

HAMBURGER steak in a can on a shelf in the grocery store isn't nearly so attractive as a sample of it served on a fancy plate, with a shiny new fork to eat it with.

Realizing this, a large canned meat company has supplied its sales-people with sample cases containing various canned meats, canned heat, plates, spoons, and knives. They set up their cases in the corners of grocery stores and feed morsels to customers. After one mouthful the sampler may become a confirmed buyer.



If you wish to gain new customers, tempt them with samples of your goods



A Motor-Turned Screwdriver

TWIST, turn—you struggle with a screwdriver. It keeps slipping out of the groove. How about the man in the shop who must drive a great many screws in a day—does he have the same trouble? Not if he uses one of the new electric screwdrivers.

The motive power is supplied by a small motor of one half horsepower or less, which may be suspended from the ceiling or fastened to the top plate of a metal stand resting on casters. The motor may be connected by a plug and cord with any conveniently located electric-light socket. A flexible shaft connects the motor with the screwdriving tool.

The edge of the screwdriver is placed in the slot of the screw, one hand of the workman holding the handle, the other steadying it by grasping the ratchet handle.

When the handle is pressed down against the head of the screw, the screwdriver engages a friction clutch at the end of the flexible driving shaft and revolves rapidly, driving in the screw to its shoulder.

This power screwdriver is lubricated with machine oil instead of elbow-grease, and saves a great deal of valuable time in the shop



There were portholes at regular intervals in the upper surface; these were closed just before the flour dust was exploded



This picture of a starch-dust explosion was taken in spite of the fact that the photographer was temporarily stunned by the force

Watch Out for Flour and Starch

EXPERIMENTS carried on by the Department of Agriculture prove that the dust of starch and flour will explode with greater force than that of a coal-dust explosion. A 200-foot steel cylinder was prepared, one end of which was left open, while the other was closed except for a small hole against which a specially made "cannon" was placed.

First, coal dust was spread on shelves inside the cylinder. The cannon set off a charge of gunpowder in the cylinder, and the coal dust exploded with a roar. After the cylinder had been cleaned out, flour dust was placed in it. When this was set off, the blast was far more violent than the coal-dust blast.

The starch-dust explosion was the worst of all. It shook houses three miles away. The earth trembled; the engineers who were watching the explosion were thrown to the ground; and the photographer who was taking pictures in a telephone-booth a hundred feet away was temporarily blinded and stunned.

A Monster Steel-Rolling Machine

ONE of the largest machines ever built for rolling steel plates is shown here. It is what is known as a 180-inch plate mill, and it has been built by an American company for the Imperial Steel Works at Kobe, Japan. Its over-all height is thirty feet three inches with the rolls together, and thirty-three feet three inches with the rolls apart. Its total weight is 592 tons.

The rolls are steel forgings 49 inches in diameter, and weighing sixty tons. Forged steel rolls are used because of the almost prohibitive prices asked by roll manufacturers for chilled rolls of that size. The preheated red-hot slabs of steel are brought up to the rolls of this machine by special apparatus and are then passed through the heavy rolls until a plate of the desired thickness is produced.



Hot slabs of steel are passed through this great rolling-machine until they have reached the required thickness

Hitch Your Rubbers to Your Shoes

DID you ever lose your rubbers in the mud? Perhaps you don't live in a muddy place, but there are others who do, and they may be glad to hear that Mr. Philip Lettore, of North Attleboro, Mass., has invented a rubber-protector that makes it impossible for a rubber to come off



This fastener will attach your rubber to your shoe, so that you can't lose it in the mud without also losing the shoe

without taking the shoe with it.

The protector consists of a spring with a hook at one end and a sharp pointed fastener at the other end. You pierce your rubber with the point of the fastener, and bend the point up over the back face of the fastener. Then you slip the hook over the top of your shoe. The spring between the two will stretch about half an inch to allow for adjustment.

How to Grow Tall

GO to bed and grow tall. It has been proved by experiment that the average person gains almost three eighths of an inch in height after a night's sleep and shrinks the same amount during the day.

A long stay in bed not infrequently increases perceptibly the height of invalids, and it is also true that the more rest a young child has the taller he will grow.

The reason for all this is that the weight of the head when we are standing erect compresses the spine.

Juggling Heavy Loads in Mid-Air

IMAGINE a giant having the lifting power of four thousand men, whose head is 230 feet above the ground and whose arms could reach outward 190 feet, and a very clear idea of the size and strength of the massive crane that was built at the League Island Navy Yard can be obtained.

Four locomotives, each weighing 100,000 pounds, can be juggled in the air at one time by the huge crane. Its great mechanical arm reaches outward and picks up one or more of the locomotives at a distance of 190 feet, dangles it in the air 141 feet above the ground, and sets it down at a distance of 41 feet from the central supporting arch.

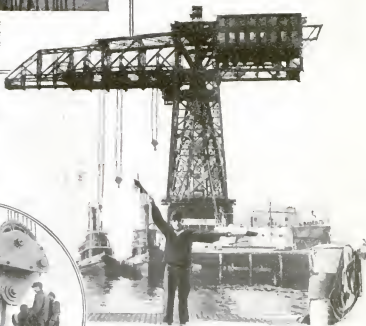
With the power of this mechanical giant the Egyptians could have built the pyramids in short order. The temple of Karnak, with its massive blocks of solid rock, could have been piled up with ease if this giant crane had been at the beck and call of the builders.

What great achievements may not be expected in the future when it is employed lifting weights to the height of a city skyscraper?

With empty hands the steel crane can operate at a speed of ten feet a minute; but when it carries a heavy load, the rate of about two and a half feet a minute is required for its operation.



It would take the lifting power of four thousand men to do the work of this lofty steel giant, which was built at the League Island Navy Yard, and is said to be the world's largest crane



One of the 100,000-pound locomotives being juggled in the air from the strong cables of the giant crane. What a thrilling ride to take in mid-air!



In the picture at the right: Getting ready for a swing in the air. Compare the size of the tackle with the size of the men

Compare this giant with the man. It is a giant crane that can dangle four locomotives in mid-air, whose brawny arms of steel can reach outward from 41 to 190 feet, and can raise a heavy weight to a height of 141 feet. The giant stands 230 feet high. It is capable of lifting 400,000 pounds to the height of a ten-story building

Blindfolded by Clear Glass

Ordinary spectacles saved this man's eyes from ultra-violet rays

By Charles Magee Adams



"I'll tell the world I wouldn't wear 'em if I didn't have to," he said as he gave the unwelcome lenses a rub and jammed the frames back over his ears

BUD BRADY, chief lineman for the North Fork Hydroelectric Company, thrust open the door of the Centerdale substation, dived inside, and slammed the door behind him in the face of a pursuing blast of rain.

"Well! Caught you, did it?" Ike Reed, the station attendant, greeted him from the near end of the purring motor-generator in the middle of the room.

Bud did not reply. Leaning his wet back against the door, he jerked off a pair of large shell-rimmed spectacles and reached into a trousers pocket. "Darn glasses, anyhow!" he growled, fishing out a dry handkerchief and rubbing the rain-splashed lenses with irritated vigor. "When it rains they're wet and get streaked; when it's hot they sweat and get streaked; when it's cold they steam and get streaked. They must think all I got to do is stand around and rub 'em all day."

Ike nodded. "Yes, I guess it is a lot o' trouble," he agreed.

Bud grunted: "You don't know anything about it. You don't have to wear 'em. I'll tell the world I wouldn't wear 'em if I didn't have to!" and he gave the unwelcome lenses a final rub and jammed the frames back over his ears.

"Pretty fair little storm," Ike remarked, with an amiable desire to change the subject.

Bud wrinkled his nose to force his glasses into position. "Thought I could make it here before she broke, but she caught me about a mile out." He shook the water from his shirt. "Liked to drown me and the flivver. There's going to be some lightning too."

And there was. Scarcely had he spoken when above the

drumming boom of rain on the roof there came a sharp crackling report from the switchboard at the opposite end of the long concrete room.

"We'll have some fun now," Ike sighed ruefully, and turning ran back to the switchboard.

The flash proved to be merely a small affair which had come in over the 33,000-volt high-tension line supplying Centerdale from the

water-power station back in the hills. It had jumped the horn-gap arresters, and Ike, with a glance over the switchboard to assure himself that everything was as it should be, returned to

where Bud had seated himself beside the front window and watched the rain swirl around the little service car parked outside.

Scarcely had he seated himself when there came a vicious crackling report. "There's going to be fireworks," Bud announced. "Guess we'd better both také a hand," and he ran back to the switchboard with Ike.

The second flash too had jumped the horn-gap properly, but Bud and Ike had no sooner made sure that everything on the wide switchboard panel was in a proper condition when a third came—a long ripping flash; and after that the flashes came in with machine-gun rapidity.

Side by side the chief lineman and the station attendant worked for five fast minutes: resetting the circuit breakers when they were tripped, opening and closing switches, doing everything in their power to protect



"What's the matter?" he yelled above the noise of the fire. "Eyes! My eyes!" Ike answered. "Don't mind me! Get the fire!" Bud saw his companion fall back, with his hands over his eyes

the lines and equipment from the storm and still maintain service. And all the time from the fifty miles of transmission line reaching up the North Fork valley the flashes continued to arrive.

Then it slackened. For a half minute there was no flash at all, only a single feeble flicker—for a whole minute simply the drumming of the rain on the roof.

"Shame it ain't the Fourth o' July," Ike grinned, mopping the perspiration from his forehead.

There was a blinding flash—a crashing report—and a huge, vivid ball of flame burst from the maze of connections and cables behind the switchboard, seemed to poise for an instant, and then broke into shooting blades of fire.

Bud knocked out the secondary switch, and leaped for the fire extinguisher on the wall at his side of the board. Ike knocked out the motor-generator switch, and leaped at the fire extinguisher hanging at his side of the board. Together they charged.

This had been no ordinary flash—not even an ordinary big flash. From one to another of the three 33,000-volt leads it had danced; and now, as the men at the power-house back in the hills turned on the current after the momentary shutting off, a long tongue of arc licked from one to another of the conductors in its wake.

Bud pointed the nozzle of his fire extinguisher at the mass of crackling flames and twisted the release valve to the open position. He saw Ike turn a hissing stream of liquid from his extinguisher, miss the fiery target by a yard, wave the stream crazily along the wall two yards from the blaze, and then, dropping the extinguisher to the floor, fall back two paces, hands over his eyes.

"What's the matter?" he yelled above the noise of the fire.

"Eyes! My eyes!" Ike answered. Don't mind me! Get the fire!"

And Bud obeyed. Until there was only a feeble trickle left in either of the two extinguishers he played their flames straight at the heart of the flames.

He was a bit dazzled by the glare, but his sight was not impaired. Yet, as the arcing subsided into a dully glowing mass of scorched tangled connections, he turned and found Ike groping blindly along the wall, ten feet from where his chair was.

"Ultra-violet rays, my boy," Dr. Vernon, the company physician, announced a half hour later as he



There was a blinding flash, and a huge, vivid ball of flame burst from the maze of connections and cables behind the switchboard

straightened from above Ike and patted a thick bandage into position. "You'll be all right before long if you just keep quiet and in the dark."

Bud, reaching for the motor-generator switch after rigging temporary connections to restore immediate service, turned. "Ultra-violet rays?"

"Yes; light rays from the arc, you know," Dr. Vernon responded.

"Then why didn't they get me too?"

Bud demanded. "I saw just as much arc as he did, and my eyes are weak."

The physician nodded. "But you wear glasses," he countered.

Bud frowned, puzzled. "Yes."

Dr. Vernon smiled: "Any ordinary glasses will filter out the ultra-violet rays. They're all that saved you."

Bud frowned and looked at Ike, lying back in a chair, his eyes heavily bandaged. Then he slowly removed

his shell-rimmed spectacles, held them up, and carefully wiped a splash of grease from one lens.

"Glasses, I take it all back," he said with respectful humility.

"You win. After this you can just steam and sweat and streak all you darned please and I won't kick or say a word, 'cause you sure saved my bacon in this here little old sub-station."

Do You Know a Story Like This?

INVENTION and adventure have gone hand in hand ever since the time when the first man pushed a log into the stream and climbing astride went boldly navigating. Modern science has ringed the world with romance in which the machine joins with man in playing the star part.

Perhaps you know such a story. If you do the Popular Science Monthly wants to print it. Remember that the story must relate an actual happening; that it must tell of how men overcame adversity, or escaped from danger to themselves, or saved others by the aid of their inventive powers or their skill in handling mechanical appliances. Not over 3,000 words should be used in the telling, and the more you can cut your story below that mark and keep a clear and interesting narrative the better chance your manuscript will have of acceptance. Payment for these stories will be above our regular rates.

Contests—But Not for Money

Speed and endurance
often mean bread and
butter as well as sport

Photographs © Harrie A. Ewing



The man who can scramble to the top of this great ball and stay there wins. The winner is here perched on top of the ball, while the men who are holding it keep turning it and throwing it up and down, the man on top never losing his place



A bonus waits for the men who can put together a first-class ship in record time; these men are trying to win it. As soon as the plate is in place the riveters begin



Here are three one-armed men in a race to see which can dress first. At the Walter Reed Hospital, in Washington, all kinds of queer contests are held by convalescent soldiers



On the last Fourth of July, before a large audience, two gangs of husky convalescents, each carrying a spouting fire-hose, approached each other. The first to let go would lose the battle for his team, so they all held on as long as they could



Three patient victims, ready to take part in the barbers' contest. They are about to be given the quickest shave and hair-cut they ever had. The winning barber did his bit in six minutes and fifteen seconds



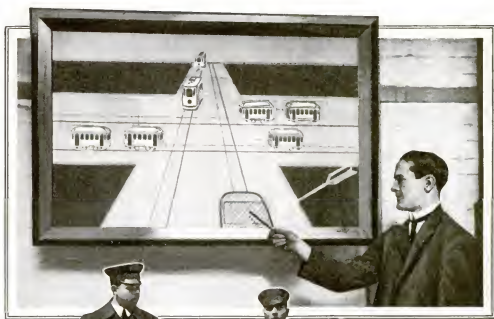
This miner won a contest by drilling a hole fifty-six inches deep in seven minutes. At the word "Go" he made his pipe connections, turned on the air and water, jumped back to his machine, and began to drill

Could You be a Motorman?

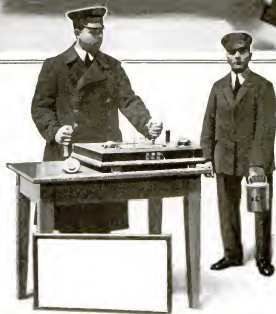
Are you color-blind? Are you nervous? Do you think quickly?



John Smith wants to be a motorman. In one test John is told to take hold of two upright rods, which suddenly begin to slide. John's power of decision is determined by the quickness with which he stops them



Next John takes his place in front of a board that shows six trolley cars meeting at a crossroads. He watches the cars very closely. An electric switch is turned on and the cars light up with different signals. John must quickly pick the car that is entitled to start first

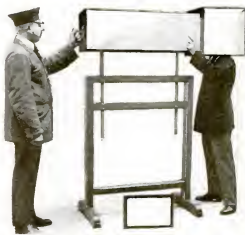


How sensitive are your joints? If you asked John this, he would take one look at you and run. Yet this muscular sensitivity must be determined before John gets his job. One method of doing this is to have him turn a crank into various positions without touching the edges of the slot.

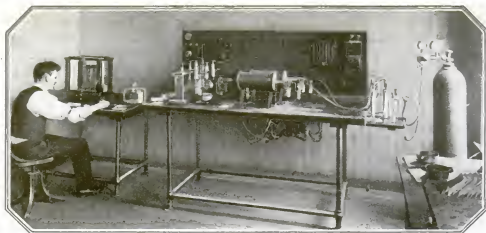
Every time the crank touches, a bell rings



In a test for vision John is given a large iron E mounted on a handle. Another E flashes up on a stand several feet in front of him. John must immediately adjust the E in his hand until it is in exactly the same position. In the picture the E is shown lying on its back



A motorman must find his way in the dark. Here is John with his head in an oblong case. When he is accustomed to the darkness, he rapidly calls out the names of objects he can see



To determine the amount of carbon in a particular piece of steel, fine drillings of the steel are weighed, then placed in a furnace, heated, treated with oxygen, and the resulting carbon dioxide is collected in bulbs, which are weighed before and after

The Shoe that Won't Strike Sparks

If you should see a track-walker deliberately step on the third rail, don't faint. He may be wearing shoes with wooden soles—and wood is a non-conductor of electricity when it's dry.

A new wooden-soled shoe is being turned out by a manufacturing company in Norway, Maine. The sole is made of polished maple, basswood, or elm, and is treated with oil to make it waterproof.

It is made in one piece and is shaped like a rocker with a groove running around the edge. The heel is of rubber, and is attached to the sole, not by nails, but by fish-line. This fish-line is also used to draw the uppers to the soles, which are cemented together.



This shoe has a wooden sole and uppers made of a fabric material; they are joined by fish-line and cemented together. The heel is of rubber. Thus the shoe is an absolute non-conductor of electricity

Making Steel that Is Hard or Soft

ALL steel contains a certain percentage of carbon, which largely determines how hard a steel is or may be rendered. For instance, tool steels contain about 1.25 per cent of carbon, while steel rails will average from .50 to .75 per cent carbon. The mild or soft steels range down to .10 or .15 per cent carbon.

It is generally necessary to determine the percentage of carbon in any steel. The apparatus above is for this purpose. Fine drillings of the steel are obtained, weighed, and placed in a porcelain dish, which is placed inside of one of the two round furnaces at the center of the table. These are electrically heated, bringing the drillings almost to the fusion point.

While at this high temperature a stream of oxygen from the tank in the corner is allowed to pass over the drillings. The oxygen burns the carbon out of the steel, forming a gas, carbon dioxide, which is collected in the bulbs to the left of the furnace. These bulbs are weighed before and after, and the increase in weight represents the carbon dioxide.

Check Your Hat, Sir?

THE prosperity of the coat-room boy is threatened by the invention of a mechanical coat-checker that will guard your coat, hat, and umbrella for one cent.

You hang all three on hooks and clamp them firmly in place by means of locking arms, securing them by means of a key. The locking arms are geared together.

To get back your belongings you insert a cent in a slot over the keyhole, where-upon the key will turn in the lock.



A mechanical coat-checker that guards your coat, hat, and umbrella, returning them for one cent

Trying Out Our Navy's Lines

BEFORE a battleship is built Uncle Sam wants to be sure of her speed. Of each ship a model is built of wood in strict accordance with the lines of the design, and at a reduced scale. This dummy, about twenty feet in length, is carefully tested in a basin specially provided.

The wooden models are placed in the basin and are towed back and forth through the water by an electrically actuated carriage which spans the water basin and runs on tracks placed on each of the long sides of the tank. The observers who make the tests occupy a booth in the center of the carriage, where the instruments used in the trials and the various controls are assembled.



In this testing basin at the Washington Navy Yard, the second largest in the world, models of all naval vessels are tried out carefully to guard against errors of construction

Buy Yourself an Ink-Stick

BLOP! You've ruined your letter with a great ink-spot. Ah, but there is a new inkless pen. In it ink-sticks are used. The stick fits into a groove in the pen. Moisten the stick in water, and the stick will dissolve enough ink to write a full-paged letter.

This ink-stick was invented by Dr. John C. Olsen, a chemist connected with the Polytechnic Institute of Brooklyn. The pen holder designed for the ink-stick has a chamber at the end for holding two extra sticks. Thus you needn't worry about the supply running out.

The manufacturers say: "It is the only pen that has been weaned from the bottle."

Ink-sticks instead of liquid ink are used by this pen; the stick fits into a groove in the pen, and is moistened with water



The aviator in the bow of this seaplane has just hurled down a white pigeon—folding the pigeon's wings close to its body so that they would not open before the bird cleared the airplane

They Built Their Air Flivver

A SMALL one-man carrying biplane has been designed and built by students of the Aviation Mechanics School at Great Lakes, Ill., from the usual materials, wood, wire, and canvas, and equipped with a two-cylinder air-cooled motorcycle engine. They also flew it successfully. It has a wing spread of not more than sixteen feet and a total weight of three hundred and fifty pounds.

We used to despair of ever seeing a successful "airmotor" of minimum weight. These students simply purchased a bicycle engine.

No material is found in their structure that was not available years ago. Thus they have strikingly revealed what all airplane inventors neglected in the early days. They saw that the most obvious requirement is a body and wing structure that cleaves the air with a minimum of effort, with everything hidden in that "body."



This one-man biplane is the product of students at the Aviation Mechanics School in Illinois. Its weight is three hundred and fifty pounds and its wing spread is sixteen feet

The Seaplane's Carrier-Pigeon

THE aviator in the bow of the seaplane reached over the side and hurled out a small white object. It shot straight down for about ten feet; then it opened, circled a few times, and disappeared. It was a carrier-pigeon.

Before the aviator let go he made sure that the pigeon's wings were tucked in close to its body so that they wouldn't open up before it had cleared the airplane. When the pigeon had righted itself and taken its bearings, it headed straight for home.

In spite of modern invention, the carrier-pigeon has lost none of its business. In fact, it is more in demand than ever. It is used by forest rangers to report fires. During the war pigeon raising and training was carried on near the front. Many a despatch-bearer started out with a pigeon in a basket on his back. Not only did the soldiers use pigeons, but practically all aviators made sure that there

was a pigeon tucked away in their airplanes before they started out.

One striking tale of a pigeon saving the crew of a seaplane at the cost of its own life is told by the pilot of a British airplane. The seaplane was making its way home after a long-distance trip, when it ran into a fog-bank. A few minutes later the engine missed, and then stopped altogether. The pilot was forced to land in a rough sea. He wrote down his approximate position, slipped the paper into the tube attached to his carrier-pigeon's leg, and released the pigeon. He had little hope of rescue because of the blinding fog. The pigeon battled its way home. It died immediately after, but the crew of the airplane were saved.

They are Going West for a Separation

THESE two are 'really one, though they hope soon to be separated. Not that they love each other less, but they find life together very uncomfortable. They are joined just below the shoulder and have been that way throughout their thirteen years of life.

They are the sons of Mr. and Mrs. Marco Godino, Filipinos now living in Washington, and they plan to go to a surgeon in the West to be operated on.

Fortunately, they are very good friends as well as brothers, and their life together has not been unbearable. Their chief difficulty is encountered in walking. One of them must always go backward. How do they sleep? We have given up trying to guess.

Abnormalities of this kind are due to deviation from the normal development of the embryo. Just why these deviations occur has not been discovered. Usually dwarfs, giants, and deformed children are born to normal parents. But should two similar freaks marry, it is believed that the children would inherit the freakishness.

© From Illustrating Services

You Would Probably Be Arrested for This

IF you used the American flag as a sheet to cover yourself with, someone would find it out, tell a patriotic society about it, and they would loudly protest. On the contrary, a pony that does the same thing on the stage is loudly applauded.

The pony's name is Julius Caesar. He fires guns, adds and subtracts figures, and always finishes his act by waving the American flag and then crawling under it.

Julius was an incubator baby. He was kept alive for eleven days in a box lined with pillows, and carefully fed with milk at regular intervals, before he was pronounced normal.



© International Film Service Co.

Apricot Pits for Dyes

AMERICAN chemists have found that apricot pits are very useful in dye-making. The pits are spread out on the ground to dry, then shipped to factories, where the kernels are removed. The kernels are then crushed to extract the oils and chemicals, from which the dyes are made. During the war the shells were used in gas-masks, and now they are being used as fuel.



Opening the Door Connects You with "Central"

WE have heard about making ships out of concrete, and other innovations in the use of concrete. Here is a brand-new use for this vastly serviceable material. Railway telephone booths, numerous along the lines of many railway systems, are likely to become standardized in the form of neat little structures of concrete, just large enough to accommodate one person.

The new concrete telephone-booth is so arranged that when the door is unlocked and opened the connection

is automatically made and the time of waiting for "central" is minimized. When the door is closed the connection is broken. A panel door with glass provides sufficient light for the interior. These concrete booths are more ornamental in the landscape than some of the wooden structures.

When an emergency call must be made, there is no delay in getting the message through. The railway employee rushes to the little booth and has merely to unlock the door and open it. When he takes down the telephone he finds the operator all ready.



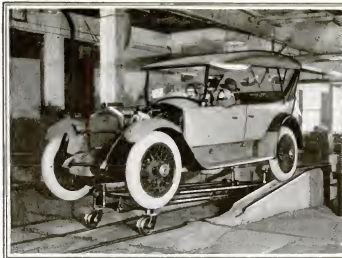
Tiny Model Houses Show What You'll Live In

"BUILD your own home!" You are always seeing signs like this one. Did you ever try it? Those who have known that a house seldom turns out the way it was expected to. The plans seem so different from the finished product.

For this reason, many architects now build a small model of the house planned and set it up in surroundings identical with those in which the house will be located. The materials and colors used in the model are the same as those of the house to be lived in. Thus you are able to judge whether it is the house you really want.

Such a little house is shown below. Though at first it looks like the makings of a Japanese garden for goldfish to play in, a careful study of it will convince you that it is a typical country house.





The Launching of an Automobile

WHEN an automobile is launched, it is assembled on trucks that are mounted on wheels that run in tracks on the floor. When the car is ready for launching, the motor is started and the trucks are wheeled backward until the rear wheels of the car strike an inclined path. Then the man at the wheel throws the gear into reverse and the wheels turn round, taking the car backward until it rests on all fours.

It's a much simpler operation than launching a ship.

Use a Pulley to Hoist Your Flag

USUALLY a pulley line is hung from somebody's kitchen window to somebody else's, and on it is hung wet wash. But pulley lines are good for other things besides wash—flags, for instance.

The flag shown below rides up and down on a pulley line—half-yards they would say in the Navy. This is a great improvement on the usual flag rope, which has to be secured in place, awning fashion, every time the flag is lowered or raised. By using a pulley, it is no trouble at all to lower the flag half-mast when some important public person is mourned.

As yet, this flag-pole is in its infancy, being small enough to fit on a library table.



How They Clear the Rails in Berlin

AN ingenious arrangement for cleaning ice, snow, and dirt from the rails of a street-car system consists of a metal rake, with a fan-shaped arrangement forming a steel frame. At its extremity are two strong spikes, each fitting into a groove of the track. Attached to a street-car, the apparatus is shoved along the track, the spikes digging out any obstruction of dirt or ice.

Ordinarily, scores of men with picks and shovels are needed for this job.

This Poor Fish Has No Tail

POOR fish! What constitutes a poor fish, anyway? Obviously the carp shown below is one; for he hasn't any tail at all. And the general belief is that he didn't lose it in a fight, but was born without it.

Think of the difficulties this fish must have encountered in learning to swim! A fish uses its tail both as a rudder and as a propeller. Without either the carp was decidedly handicapped and had to overwork his fins.

Perhaps this lack of a tail led to his being caught.



© Publishers Photo Service



Now the X-Ray Has Gone into

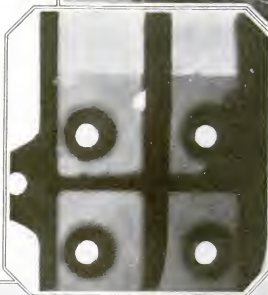
If you suspect a hidden corrosion in reason to think that a workman is

THE uncanny property that X-rays have of penetrating substances, whether they are transparent or not, is now turned to practical account. If the X-rays can discover just where the safety pin lodged that baby swallowed, why shouldn't it also explore the hidden interior of a casting or a piece of timber for defects? So British scientists have reasoned, with results shown in the collection of pictures on these two pages.

The X-ray has been used to discover whether there is a flaw or crack in a metal weld. The steel manufacturer has radiographed his castings and forgings in order to localize the blow-holes and other concealed imperfections. The airplane inspector, with the aid of the ray, has searched for hidden faults in workmanship that outwardly satisfied the eye.



Here was a casting for an airplane engine that would have passed any inspector. Major J. Hall Edwards, of the Royal Air Force, turned on the X-ray. And what did the X-ray show? A large blow-hole. Much work had been done on the casting which would have been saved had the X-ray photograph been made earlier. But the experiment proved that the time has come when the careful manufacturer must add the X-ray to his inspecting equipment



In the box resting on the floor is an X-ray tube. Upon it rests a wooden member that is to form part of an airplane. Upon the wooden member a fluorescent screen is placed. The man who is bending down is looking at the fluorescent screen for defects in the wood. This is the quickest way of examining wooden aircraft parts with the aid of the X-ray for defects



The X-rays showed a defect in the gasoline-feed canal of this carburetor, thus saving hours of effort in locating the trouble



A brave man's life was saved when this X-ray photograph was taken. The internal strength of this block was badly fitted; each of the screws had split the wood; the work was altogether discreditable. And so the piece was rejected. If it had not been for the X-ray it might have been a part of an airplane which would have collapsed at a critical moment

the Business of Manufacturing

the armoring of a cable, if you have concealing mistakes, turn on the X-ray



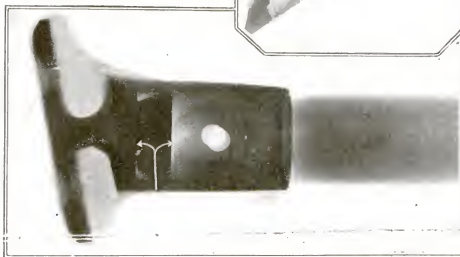
Here they are assembling the X-ray apparatus that is to be used for inspecting airplane timber with the aid of fluorescent screens. The picture opposite shows how the fluorescent screen is used. The chief faults to be looked for are spiral grain (in spruce and in substitutes), knots, resin, pockets, compression shapes, incipient decay, grul-noles, and very light woods



If you wonder whether there is a hidden corrosion in a gas-cylinder, if you suspect that gutta-percha has been adulterated, if you have reason to believe that a workman is cleverly concealing his mistakes or his carelessness—turn on the X-ray.

When a strut or spar of an airplane is completely covered with fabric, veneer, or plywood, it is easy enough to fool the inspector. But you can't fool the X-ray. The detection of one such fault with the X-ray resulted in the rejection of dozens of completely finished main wing-planes in a British factory. In one fuel-tank the rivets were found to have heads on the outside only. Cracks in the airplane timber are sometimes cleverly hidden by gluing a shaving over the sand-papered surface. The eye overlooks them, but not the X-ray.

In every well conducted aircraft factory you will find a notice that reads: "A concealed mistake may cost a brave man his life." In spite of that, mistakes have been concealed. Now comes the X-ray to protect the flyer. Here we have an X-ray photograph of a fuel-tank for an airplane. Its defective riveting and soldering stand out glaringly



The wooden skid of an airplane was cut off too short to fit into its socket. In order to make up the length, a piece of packing (here marked with an arrow) was introduced into the space below. The workman responsible thought he could "get away with it"; but the X-rays found him out



Major J. Hall-Edwards of the Royal Air Force photographed loaded rifle cartridges to show how the distribution of the lead would influence their flight. In the center is the old round-nosed bullet

Dramatizing Geography

As history unfolds itself on a forty-foot globe

AT a luncheon-table in San Francisco a dozen men—university graduates, most of them—talked about great-circle sailing.

"The great circle from Panama to Yokohama," said one of them, "passes west of San Francisco from one hundred and fifty to two hundred miles."

"You're wrong," retorted another. "The circle will pass east of San Francisco at least two hundred miles."

No one believed him. Even a small school globe did not convince them. And so the objector started to prove his point by means of a Mercator's projection. To his astonishment, no one seemed to know how charts are made and the real meaning of meridians and parallels.

The man who thus set out to prove his contention scientifically was

Marsden Manson, an engineer. As a result of this experience, he invented a system of breathing life into geography. Instead of learning it from dead maps and dull text-books, he would teach it as a living, changing subject, which indeed it has been in the last five years.

Mr. Manson makes a veritable motion picture of geography. It is produced in a kind of theater. Out in front is a stage. Presently the curtains part. A huge globe is revealed—a globe forty-two feet in diameter, or one one millionth as big as the earth itself.

The globe becomes animated. All Europe seems to twist and writhe. You see it literally in the geographical throes of the terrible war. Germany pushes her boundaries into Russia and Belgium; Austria her own boundaries

into Rumania and Italy. Back and forth the boundaries shift. And then you see revolution tearing Russia apart. Look to the west. The armistice has been signed. You know it because Alsace and Lorraine suddenly attach themselves to France; parts of Austria become Italian.

Back of the auditorium is the housing of a motion-picture projector. The lamp projects on the globe a film which shows very realistically what men have been fighting for, even though it is but an animated map. Also the lecturer's assistants on the stage operate mechanism for rotating the globe, and for varying the inclination of the axis realistically—which, with the cooperation of the light-projecting operator, illustrates the changes of day and night and the seasons.



Animated geography teaches as no text-book can. You see a moving picture in which contour lines play exciting parts: some are villains, some heroes, some bullies, and others protectors of the weak

How to Get the Lid Off an Egg-Crate Without Breaking It

YOU have heard a good deal of grumbling about the high cost of eggs, but has anyone told you about the high cost of egg-crate lids? At the present time they are worth five cents each, and therefore should not be ripped apart when the crate is opened.

Recently there has been invented a crate-opener that will pry the lid off a crate without breaking the lid at all. The implement consists of a handle with a broad, flat blade at the end that is as wide as an ordinary crate lid. A

He's prying the lid off a crate of eggs with a new crate-opener that will not break the lid. It consists of a flat blade and handle mounted on a rectangular frame for support

rectangular frame is attached to one side of the blade, and the opposite side fits against the crate.

The frame acts as a fulcrum for the blade when you press down on the handle.

The invention enables one to remove the lid of crates without the damaging results that are usually obtained when one tries to pry off the boards with a hammer. The wood splits, spoiling the crate until new boards can be obtained.



Inside the telescope a photographic plate is inserted and is exposed for several hours, while the telescope moves slowly to keep up with the stars. On one photograph taken by this telescope four hundred thousand stars were counted

Taking the Stars' Pictures

MANY times when you were young you tried to count the stars; but at last you gave up trying. Yet those stars have been counted by astronomers, and are continually being recounted in order to find out whether any small ones have been overlooked. But the work is done on photographs of the sky that were taken at night.

Above you see the sixteen-inch double telescope located at Harvard University that is used especially for photographic work. A plate is inserted at the lower end of the telescope and is exposed for hours. All the while, the telescope moves slowly to follow the stars as they travel across the sky. On one photograph four hundred thousand stars were counted.

Owing to the large size of the plates, the first photographs taken were somewhat blurred at the edges. To overcome this the plates were sucked into a curved form by air pressure while in the holder. Thus all points were equidistant from the focal point of the telescope.

Over-Exposed Blueprints

WHEN blueprints have been too long exposed and would wash out too dark, the defect can be corrected to a great extent.

First, wash the prints in running water until all the blue liquid clears away. Then soak the prints in a solution made up of one teaspoonful of hydrogen-peroxide to each quart of water. The soaking should continue until the proper color appears. Then wash the prints again in clear water.

The process may be carried on while correctly exposed prints are in the same batch.

Is This Waist a Waste?

AT first glance you are apt to think that the lady in the picture shown here is wrapped up in the parlor curtains; but when you look more closely you notice the great beauty of the lace, and realize that it is out of the curtain class. As a matter of fact, it is a waist and it cost the sum of thirty-five hundred dollars.

It is made of old rose-point lace, and it came from Belgium. The lace had lain in the dark for so many years that it is now the color of old ivory. In its present waist form it is held together by ropes of tiny pearls and is draped over a lining of silver cloth.

You can buy lace like this by the yard—that is, if you can pay a thousand dollars a yard.

It is interesting to note that the regions where pictorial art first flourished—Italy and Flanders—were the ones in which lace-making was originally developed. In the seventeenth century, nuns in many places established lace schools where the peasant women learned the art.



© International Film Service Co.

The most expensive waist in captivity is shown here; it cost \$3,500. The lace used in the waist is very old and it was made in Belgium

"The Man that Hath No Music in Himself."

He stands alone in a world of music



Music and the dance go hand in hand. In the white man's land the music is often furnished by an orchestra of many pieces. It frequently inspires very beautiful dancing



© Press Illustrating Service

Turn, tum, tum! The Moro boy pounds a cymbal while his sister dances. The cymbal and the drum are the favorite instruments of the Moros—one of the Mohammedan tribes in the southern Philippines



© Press Illustrating Service

Two pieces of gas-pipe, an old tin funnel, and some axle-grease will make, we are told, a "unique tone-producer." A marine made one and called it his bazooka. With it he furnished jazz at a recruiting station



© Press Illustrating Service

The Indo-Chinese laborers who were in France during the war made their own violins. A piece of wood, a tin can, and some wire were all they needed. While the musicians played the gang stood round and sang

"Music hath charms to soothe the savage breast." This religious healer of Siberia must have known it when he decided to carry a drum and bone drumstick with him. His charm in drum-beating to drive out evil spirits

Siamese twins—not the famous two-in-one—are shown at the right. One of them is playing on a bamboo flute. There are seven reeds to the flute, and they produce very beautiful music—or that is what the Siamese think



© Press Illustrating Service



© Press Illustrating Service

Giving Big Ben a Bath

He ticks on top of England's House of Parliament



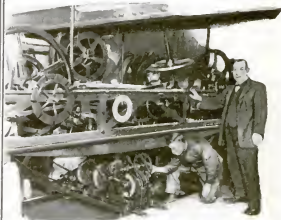
This is Ben's belt. If you look at William (the man with the mustache, standing at the left of the clock) you will appreciate the size of the bell



Ben's face, as you see, is exposed to all kinds of weather, and in consequence needs to be washed regularly. London's Big Ben is a very famous clock



With a lighted candle and a soapy wash-cloth, Algy enters the room of the pendulum. In spite of the fact that the pendulum is well cloistered, it does collect some of the dust and dirt of the world



What makes the hands go round? All these wheels and chains—commonly known as the "works." They must be oiled and greased regularly if they are to function properly

Manicuring him is not an easy job. He has four faces, and therefore eight hands. One of his minute-hands, fourteen feet long, is being removed here. If you look down at the wagons in the street below, try not to grow dizzy or you may topple over



© Press Illustrating Service

Fear not; the Capitol is not on fire—just plain dirty. The fire department is giving it a bath

The Capitol Gets a Bath

THE Capitol building was particularly dirty this year, and needed a very thorough scrubbing. Some say it was due to the great amount of "mud-slinging" in Congress, but we believe that it was honest dirt caused by the unusually large amount of rain that fell during the year.

Indifferent to causes, the fire department brought out its most powerful hose and gave the Capitol a thorough bath. The firemen washed the roof, the walls, the pillars, the statues, the steps, and if the building had had ears they would undoubtedly have washed it behind the ears, too.

What Is Wood Alcohol?

NEWSPAPERS report, "Scores die from drinking wood alcohol." What is wood alcohol? Is it a relative of the alcohol contained in wine, beer, and distilled liquors? Both belong to the carbon-hydrogen compounds of similar molecular structure forming the alcohol group, but are radically unlike in derivation.

Drinkable alcohol is a product of the fermentation of vegetable substances containing sugar, starch, or dextrose; while wood alcohol is obtained by the destructive distillation of wood. Pure wood alcohol is a colorless, clear, and mobile liquid, highly inflammable, and of an unpleasant odor. In the pure state it can easily be distinguished from wine spirit by its odor, but when it forms a comparatively small part of a mixture containing flavoring matter, its odor is obliterated.

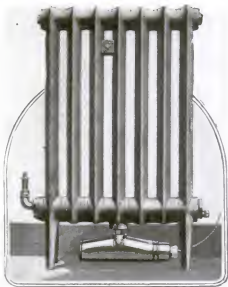
Diluted, it resembles in taste the cruder varieties of wine spirit; but even in small doses it is extremely poisonous, causing death or blindness. In the process of digestion wine spirit is split up into carbon dioxide and water, both harmless; while wood alcohol is changed to formic acid, formaldehyde, and other poisonous substances.

An Electric Steam Heater

IF you have ever lived in a suburb you surely have met the steam radiator operated by gas. You fill the radiator with water and turn on the gas below. The water soon boils and you have steam heat.

In France they are using an electric steam heater that is somewhat like the gas radiator. You fill the radiator with water, but instead of turning on the gas you press an electric button. The current passes through an electric heater located below the radiator; a resistance winding heats up when the current passes through, and this heat is transmitted to the water in the radiator.

Thus steam heat is obtained without the necessity of piping a house.



You fill this radiator with water, press an electric button, and have steam heat

Will She Take Home the *America's* Cup?

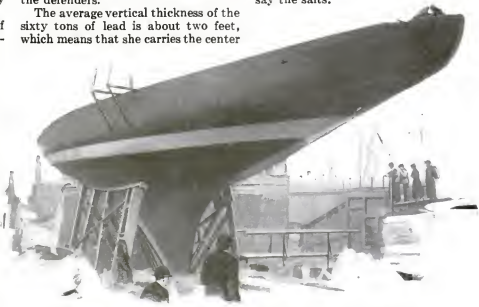
SHE looks like a fish out of water—a man-made fish; for she is the *Shamrock IV*, Sir Thomas Lipton's challenger for the *America's* Cup.

After lying housed for five years the yacht was recently put on the ways for an overhauling, and racing sharps got a look at her under-water build. The feature that chiefly attracted their attention was her unusual length of keel—thirty-five feet, or more than twice that of the *Resolute*, probably one of the defenders.

The average vertical thickness of the sixty tons of lead is about two feet, which means that she carries the center

of gravity very low, lower than her rivals, the *Resolute* and the *Vanitie*. And that means great sail-carrying capacity; so it is no surprise to learn that she is to have a spectacularly lofty rig. But the long keel means a large increase in wetted surface, and the experts say that, while she will be fast in fresh winds, she will be at a disadvantage in light breezes, when the amount of wetted surface is important.

"A dangerous contender in a blow," say the salts.



This strange-looking object is the hull of the *Shamrock IV*, with which Sir Thomas Lipton hopes to capture the *America's* cup this summer

Follow the Sound of the Horn to the Fire

HONK! A horn sounds from every other block down the street from above each fire-alarm box where it is fixed—a loud, continuous noise.

The Atlantic City Fire Department has attained a record for its great speed in response to an alarm, and credit is given to the new system. When an alarm is turned in, the horns above the boxes at every other street down the main thoroughfare begin blowing, and at the sound all traffic stops, clearing the way for the fire-engines.



Above the fire-box is a horn connected with the alarm, to warn people of the coming fire-truck



Birds eat most of the insects that would destroy the crops; for this reason farmers ought to construct houses for the birds



The houses should be of a size to accommodate the birds they are intended for, and when ready hung in trees

Build More Bird-Houses

IF the twittering birdies wake you at dawn don't growl at them. Rather, be thankful that they are wide awake and ready to do a full day's work. For the birds eat the insects that would otherwise destroy the crops that you expect to eat. We are told by a well known entomologist that if birds became extinct the world would be uninhabitable for man. Therefore build bird-houses and hang them up wherever food grows.

The floor surface of a bird-house for wrens and other small birds should be about four square inches, and the height ten inches. Bluebirds need a house slightly larger. Neither wrens nor bluebirds nest in the same place

twice, for which reason it would be wise, when building houses for them, to construct several compartments, so that the birds can move from one to another each season. The entrance hole for wrens should be one and one quarter inches in diameter.

Six by six by six are the dimensions for the home of the song sparrow and for the majority of birds, the entrance hole varying with the size of the bird.

Ninety-five per cent of all insects are eaten by birds. In the stomach of one swallow two thousand mosquitoes were found, and in their midst were several flies and cucumber-bugs. A closely watched red tanager was seen to eat thirty-five moths in one minute!

The Secret of the Praying Palm

NEAR Fariidpur in Bengal is a date-palm which bows down as if to prostrate itself when the temple bells ring in the evening and which rears its head again in the morning. The tree must have been displaced by a storm; for it now grows at an inclination of about sixty degrees to the vertical.

Sir Jagadis Chunder Bose, director of the Bose Research Institute of Calcutta, is known all over the world for his remarkable studies of sensitivity not only of living plants but also of metals. Sir Jagadis has invented instruments of amazing delicacy. In a sense, he gave plants a pen and let them express themselves. Sir Jagadis provided the praying palm with one of

these recording instruments. He said to the palm as it were: "Here is a pen: tell me why you pray."

The owner of the tree objected to this proceeding. But Sir Jagadis removed his misgivings by telling him: "The instrument will be attached to the tree by one of my assistants, who is the son of a priest."

And what did the praying palm write? In the first place, all trees, all plants

move. That Sir Jagadis proved long ago. Hence, the praying palm is not a miraculous tree. Its motion is more noticeable than that of other growing trees and plants because it is inclined to the vertical, so that the movement of trunk and leaves became easily noticeable by reference to the ground.

All plants are sensitive to light, but Sir Jagadis proved that light is not the cause of this "praying." What then?

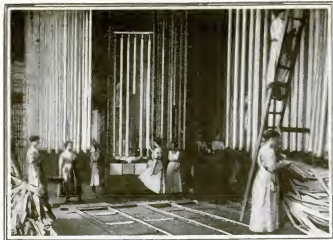
The rise and fall in temperature during the day. The record of movement of the tree was found to follow the fluctuations of the temperature at different seasons with astonishing fidelity, a rise of a few degrees being followed by a fall of the trunk, and vice versa.



In the morning the praying palm with uplifted head greets the sun



But as the temple bells ring in the evening it bows down as if in prayer



Germany is now making sausage skins of silk; these young women are coating them

Silk Stockings for Sausages

DO you eat the skin of German sausage? Don't do it: the Germans are making the skins out of silk now.

The silk is woven like a seamless stocking, and is then coated with what the Germans call a "subtle mass" resembling what we call the "dope" applied to the linen of airplane wings. It gives the silk sausage stocking solidity as well as elasticity.

The meat is stuffed into the stocking and the resulting sausage is dried and smoked, after which the meat and the skin cling firmly together.

Above you see a room full of sausage skins hanging from the ceiling. They are being coated by the girls of the sausage factory.

He Enjoys Using This Riveting-Machine

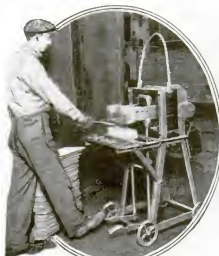
"**A** HARD life!" That's what you say when you talk of riveters, rivet-heaters, and their helpers.

But is it so hard? Look at the man above. His job is heating rivets, and it is really no worse than toasting marshmallows. In fact, he seems to enjoy using his new electric heating-machine.

A transformer is mounted on the rear part of the machine. Two heavy copper bars connect it with two heavy air-cooled electrode blocks of cast copper located in the front part of the stand. Under these two blocks, which can be raised or lowered separately by individual foot-levers, is another copper block that holds the rivets in a vertical position and forms the other electrode.

In operating the heater, two rivets are placed in the vertical holes in the lower electrode. Then the upper electrodes are permitted to drop into contact with the heads of the rivets. The tap switch mounted on the rear legs of the stand is closed, and the current, passing from one electrode to the other, heats the rivets between them to any degree desired.

The amount of current is regulated by a rheostat connected with the switch.



With one of these heaters one man may bring five hundred rivets to white heat in a single hour

The Sword of Pershing

WHEN the people of Missouri decided to present General Pershing with a memorial, they made it a sword of gold, studded with jewels.

The saber is of the finest steel, but the hilt and scabbard are of eighteen-carat green gold. Rubies, diamonds, and sapphires are set in hilt and scabbard. The green gold of the scabbard is designed to resemble laurel wreaths, outside of which the General's military record is inscribed. Pershing's four stars, denoting his rank of general, are wrought in platinum and encrusted with blue and white diamonds.

Military experts say that this sword is the most exquisite design ever produced in an American shop, if not in the world.



Pershing's sword, given to him in honor of his work in the Great War, is made of gold and studded with jewels

They Will Be the Biggest Guns Afloat

THE largest guns afloat will soon be the boast of the United States Navy. There are now building 190 such sea monsters, 16-inch guns, each with a muzzle energy of 115,000 foot-tons. They fire projectiles weighing 2,100 pounds, so that the 190, if shot off at once, would hurl nearly 200 tons of metal at the enemy. And to do it they would burn 125,000 pounds of powder in about one twentieth of a second.

The power of this terrible discharge represents energy enough to lift a battleship to the height of the Washington Monument. It is said that these guns are not only of greater power than the 14-inch, but last longer.



The Mammoth was designed by the eight passengers instead of a load of



There are more than a thousand diamonds in this crown and cross

The "Ad" of a Thousand Diamonds

MORE diamonds and silk shirts are being bought today than ever before in history. And most of them are adorning the ten-dollar-a-day workman. The result of this great demand has been a two hundred per cent increase in the price of diamonds in the last few years. Yet still the workman clamors for more.

A prosperous New York jeweler hung up in his window a cross fourteen inches high and a crown seven inches across the base made up entirely of diamonds! More than a thousand diamonds were used, their aggregate weight being five hundred and ninety-five carats. The two pieces were valued at four hundred and fifty thousand dollars. The crown contains two hundred and one carats, and the cross is made up of three hundred and ninety-four.

Class Distinction in the Air

BUY your ticket, first or second class, take a seat in the electrically lighted and heated fuselage, and your travels through the clouds will demonstrate the progress of aviation in the past ten years. Class distinctions have gone flying; that is, they have taken to the air, now that an airplane has been built with accommodations for first and second class passengers.

Blériot, the audacious aviator who first flew across the English Channel in a monoplane, designed this latest of flying giants. The fuselage, or body, has two decks, an upper and a lower. Twelve first-class passengers view the scenery through the twelve windows in the side of the upper deck, while sixteen second-class passengers occupy the lower deck and have six windows at their disposal.

The new type *Mammoth* was designed to be a bomber; but the war ended before the machine was perfected.

A change in design made it adaptable for commercial use, and now it carries passengers instead of bombs.

A front view shows the enormous size of the airplane compared with the two small biplanes under its great wings, which have a spread of ninety feet. The top plane is straight, while the lower plane slopes up from the center toward the tips to produce what is called a "dihedral" angle, the purpose of which is to give stability in flight. Four Hispano-Suiza engines, of 300 horsepower each, are mounted in separate power "eggs" driving separate tractor air-screws. In the center is the fuselage, the pilot's seat being in front on top.

This great mechanical bird, can fly seven continuous hours at eighty miles an hour. It has little to fear from forced landings, since it can stay in the air under the power of its engines; it also has eight large landing wheels.



Showing the windows in the side of the fuselage, the upper row being used by the first-class passengers, the lower row by the second-class passengers



English as a bomber. The war ended before it was perfected, and so it was rearranged to carry twenty-bombs. Its great size may be realized by a comparison with the two small biplanes under the wings



Many families would be glad to live in a hog-barn like this. It has concrete floors, stove heat, electricity, and windows all along the roof to let the sunshine in.

What a Home for Pigs!

TO be sure, pigs aren't particular about the kind of house they live in as long as they get plenty of swill to eat. But successful pig-owners are the ones that make sure their pigs have plenty of light, fresh air, and a clean place to sleep in.

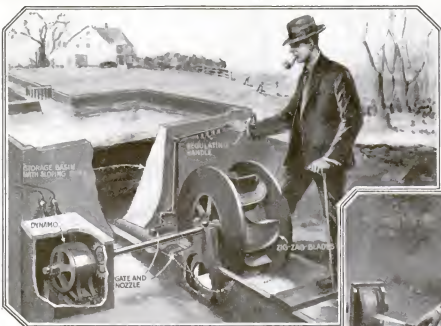
One pig-raiser built his pig-pen on the side of a steep slope, and, to insure his pigs plenty of sunshine, put eight windows in the sunny side of his slanting roof. The building is sixty feet long and twenty-two feet wide. The walls and floor are made of concrete and the roof is covered with the best grade of roofing paper. The hog-barn is lighted by electricity and a stove heats it in very cold weather. There are two fresh-air ventilators in the roof.

Alas! it is to be feared that the pigs don't appreciate their beautiful home.

Speeding Up the Water-Wheel

AS for water-wheels, maximum power from minimum water—that is their goal. Will straight blades help them attain it? James Charles, of Richmond, Ind., says no; and so he has invented a water-wheel with curved blades. These blades are all fastened to a large central hub, and the direction of the blades alternates: one curves to the left and the next to the right. The blades are joined at the ends, and they thus assume snakelike formation.

When water hits the wheel, it must travel through this winding course before it gets out; and thus its force is felt for a longer time than if the straight-bladed water-wheel were used. Mr. Charles has made actual tests of this power by turning a hose on a miniature water-wheel having straight blades and later hosing a curved-bladed wheel of the same size. He says that he got far more action from the curved one.



Two model water-wheels: the one on the left has straight blades; that on the right has curved ones that are fastened to a hub. Which one will generate the more power?

Music as She Is Played on Electric Anvils

GRAND opera in the high school! The enterprising students in the Lafayette School of Oakland delighted an audience at a school entertainment by rendering the "Anvil Chorus" to a full chord accompaniment, making use of a clever electrical arrangement. The anvils were full-sized reproductions of the blacksmith's equipment, camouflaging a set of inlaid pipes. Not only was it necessary to produce harmonious sounds when the anvils were struck, but realistic sparks must be thrown into the air.

A stage cable, outfitted to plug in on the circuit, was used in connection with carbon lamps as voltage-reducers, furnishing an abundance of sparks. The player in the center has to learn the pitch and position of the seven tones of the scale, and likewise memorize and carry his part in the celebrated chorus from "Il Trovatore."



The High School "Anvil Chorus." The hammers make contact, and electric sparks fly, vividly imitating the sight as well as the sound of the smithy's art.

The inventor of the curved-bladed water-wheel turned a hose on it, and later hosed the straight-bladed wheel; the curved one turned faster, generating more power.

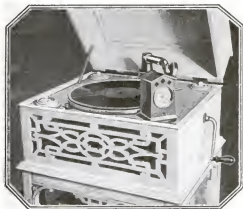


Awake to the Sound of Sweet Music

"OH, how I hate to get up in the morning!"—wouldn't you rather hear that sympathetic tune than the alarm clock each morn? Or perhaps you prefer a hymn or a waltz? If you own a phonograph and a clock like the one shown, waking to the sound of music becomes possible.

You choose your record the night before, put the needle in place, wind up the machine, and switch on the lever. But before it has gone as far as the music you clamp down on top of the record a metal arm that extends out from the back of the clock. This arm is worked by a button on the face of the clock.

Here's where the clock plays an important part. You set the alarm, just as you would in any other alarm-clock. But, instead of sounding an alarm at the given time, the clock lifts the metal arm from the record, the record turns, and you are awakened by your favorite musical selection.



Set the alarm clock, clamp a metal arm down on the record, and when it's time for the alarm to go off, you will hear sweet music



© Press Illustrating Service

The sign tells the tale. You wait on yourself and tip no one



© Press Illustrating Service

At the small price of fifteen cents you can go into this shop and shave yourself. Necessaries like the razor, soap, and brush will be supplied without extra charge. Such luxuries as hair tonic and powder may be had at a reasonable price. Don't be alarmed at the policeman's presence—he is simply curious about the innovation

The "Help Yourself" Barber Shop

"SHAVE, 15 cents."

In big black letters this sign appears on the window of a barber shop.

You walk in, pleased with the reduced rates, and there you see several men lined up in front of mirrors, and discover that they are shaving themselves. There isn't a barber in sight!

When a barber shaves you, he does it with pomp and ceremony, which is all very well if you have plenty of time. Then, when he has put on the finishing touches, he charges you thirty-five cents, and you generally tip him a dime besides.

Compare the time and money spent

in the "shave yourself" and the "get shaved" barber shops. When you shave yourself, you tip yourself and do the whole job rapidly. The soap, brush, and razor are carefully sterilized before they are handed to you. If you need a hair tonic you may have as much as you want for an additional fifteen cents. Other luxuries, such as powder or cold cream, may be had at a very small extra charge.

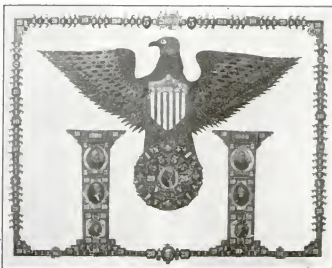
Razor-makers spend thousands of dollars in advertising. Would it not be a good idea for them to establish cheap "shave yourself" barber shops in which their razors would be used exclusively?

Thirty Thousand Dollars Went into This Eagle

GREENBACKS or yellowbacks that were accidentally torn in the money room of a bank have been put into decorative use by A. J. Bame, of New York city, in the making of a mosaic 22½ by 28½ inches. The original would have an intrinsic value of \$30,000 if it were made from good bills.

More than two thousand pieces are contained in the design, and Mr. Bame put into the task all of his spare time extending over a period of ten months.

Each piece of the mosaic had to be ironed out and cut with small scissors. Many of the pieces were so small that they had to be held by a



A mosaic design pieced together from cut-out bits of paper money accidentally torn in the money room of a bank

pair of tweezers in order to cut them.

The very lifelike eye of the eagle was made from the figure 2 with the bottom cut off, while the beak was from the yellow back of a twenty-dollar bill.

The little designs found on five-dollar bills were used for the feathers in the eagle's head, and the neck feathers came out of two-dollar bills.

The red and blue stripes in the shield were obtained from the colored seals on the bills, while the white stripes and the stars were simply a background of white paper, the stars having been cut out with a penknife.



© International Film

The largest Bible in the world is being written by the people of England to help the religious drive of 1920; the verses are written, signed, and pasted on the three-foot pages of the book.

In Great Britain Everybody is Rewriting the Bible

TWELVE thousand English men and women are rewriting the Bible. Not that they don't approve of it in its present form: they are simply getting ready for the religious drive of 1920, to be known as the Bible Crusade of England.

This Bible will be the largest one in the world—more than five feet high and three feet broad. Each contributor has been assigned a set of verses that he or she will write and sign. The King and Queen are going to do their share of the work.

The book contains one hundred and seventy-five sheets of stout paper boards on which the verses will be pasted. It is sewn with twine and bound in rich Levant morocco leather. Twelve extra large goatskins were needed for the binding.

When the Bible is completed it will go on a tour of exhibition in England, Canada, and Australia, and also in the United States.

One Hundred Tons in a Lump of Steel

"It weighs a ton." We used to say this when we wished to denote great weight. But a ton is a mere trifle today.

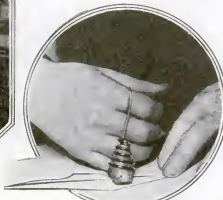
Look at the steel ingot in the picture to the right. It weighs one hundred tons, and the three workmen who are guiding it are quite indifferent about it.

The ingot was poured at Creusot, France, from three forty-ton furnaces, all working at the same time, to insure uniformity throughout. It was slightly conical in shape, and thus was easily lifted from the form. The crane that carried it off grasped it near the middle, so that it wouldn't be apt to slip through.

Efficiency in Sealing Envelopes

LONG ago you stopped licking the backs of envelopes because it was unsanitary. Now you buy a sponge, wet it, and use it in place of your tongue. Perhaps you find the sponge hard to manipulate. If so, you will be interested in the new envelope-moistener recently invented by John B. Mullally of Seattle, Washington.

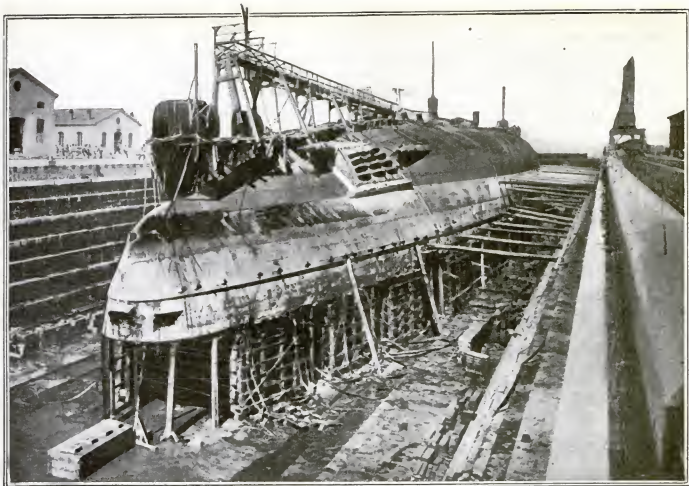
A small sponge fits in a metal coil that is attached to a metal band. On the band there are two rings that you slip on your first and third fingers. You wet the sponge before you put it in place. As it hangs over the side of your hand, you need only move your hand back and forward on the envelope flap in order to moisten the paste. For further directions, see the picture.



A sponge for wetting envelope flaps fits in a coil that is attached to a band which you wear on your finger



This huge steel ingot weighs one hundred tons; it was poured from three furnaces all working together, to insure uniformity throughout



After three years of stupendous effort the *Leonardo da Vinci*, an Italian war-ship that had foundered as a result of an internal explosion, was towed to its dry-dock upside down

Upside Down to the Dry-Dock

WHEN a huge vessel, such as a war-ship, is brought to the dry-dock upside down, one can imagine the magnitude of the calamity that caused the wreck. On August 2-3, 1916, when the Italian war-ship, the *Leonardo da Vinci*, was resting at anchor in the channel of the Mar Piccolo, a fire broke out in the munition stores in the stern. Immediately there occurred a gigantic explosion, tearing two great holes in the vessel and causing it to founder. More than two hundred seamen were killed, and twenty-one officers were among the missing. Subsequent inquiry attributed the cause of the disaster to two Italian workmen employed in the arsenal, and the men were consequently shot as traitors.

The holes in the war-ship torn by the explosion were about thirty-two feet in length and sixteen feet wide, and were open mouths into which the turmoil of swirling water poured, the inrushing currents causing the vessel to capsize. The turrets and upper works rested finally in the soft mud on the bottom of the channel. The keel and part of the bow remained above the water, the depth being about thirty-six feet.

What would be the quickest way to get rid of the obstruction? At first the ship was regarded as lost. But, being in sheltered water not far from the arsenal, the officers in charge began to consider proposals as to how the wreck might be salvaged. One suggestion was to build a dike around the ship or to roll it over on the bottom until it assumed an upright position. The task of salvaging the war-ship was given to General Ferrati. He suggested that, instead of trying to turn the ship over, it could be floated in its unfortunate position, and upon this plan the work was started.

Divers found that in "turning turtle" the ship had nearly severed the firing turrets. These were removed, and some of the cannon were raised from the mounts. Then the explosion holes were plugged. After this extensive preparatory work, pumps removed the water from within the hull. The water was brought down to twenty-six feet in almost the entire ship, and the munitions in the central and foremost stores were saved. Then a successful attempt to save the coal was made.

The portholes and other openings had been plugged when the large rents

torn by the explosion were closed, and with the removal of the water came the next step—floating the vessel. Compressed air was pumped into the hull, making it a huge caisson in which workmen could continue their work.

After twelve months of stupendous effort the weight of the vessel, after the removal of its exterior detachable parts and its munitions and coal, was reduced from 24,000 tons to 18,000 tons. Then eight cylindrical barrel-like tanks were employed to lift the ship from the bottom and make it ready to be towed to the dry-dock.

Four tanks, each weighing four hundred tons, were attached to the bow, and four were attached to the stern to give the necessary stability to the ship while being lifted. The bastion of the second turret was removed with great difficulty during the lifting of the stern of the war-ship. When the decks, upside down, were cleared, the work of actually floating the ship in its curious position was completed, and the towing to dry-dock began. It was at the beginning of September, 1919, more than three years after the disaster, that the ship was finally towed upside down to its dry-dock.

To the Bottom of the Sea in an Automobile



THE diver is perfectly at home when he hits the bottom of the sea, but on the way down he's as helpless in the water as a fish is out of it. Besides, some of his connecting tubes are apt to become twisted and put out of order. But a recent invention makes it possible for a diver to travel down comfortably in an armored car. The car is lowered from the deck of a scow by means of a powerful crane.

This new diving-car is made of heavy riveted steel plates, and rests on four wheels—those in the rear, the drive wheels, being provided with treads. Inside there is a motor for propelling the car, tanks filled with oxygen,

air, acetylene under pressure, an apparatus for regenerating vitiated air, tools, benches, and cots for the divers to rest on. Each diver wears a light, airtight suit and a heavy copper helmet. He carries on his back two steel bottles, one containing compressed air and the other oxygen under high pressure. Tubes connect the bottles with his helmet and thus supply him with air for breathing under water. The air he exhales passes into a tank on his back, and is regenerated by chemicals. Telephone wires are the only connection he has with the world above.

On top of the car is a powerful searchlight to guide the diver while he works.

Turn the Crank and Clean Your Gloves

MAKING ice-cream? You naturally ask this when you look at the picture below. He merely is using a new glove-cleaning machine, and he is the inventor, James West, of Jamaica Plain, Mass.



As he turns the handle a perforated blade within the container whirls round and stirs up gloves and gasoline; after three minutes the gloves will be clean

As he turns the handle a blade within the cleaner whirls around. This blade has long, narrow perforations through which the cleaning fluid is forced rapidly. The blade revolves on a central shaft and extends the full width of the container.

You first drop your dirty gloves in the cleaning fluid—gasoline will do—and fasten down the lid. Then you turn the handle for three or four minutes, and when you take out your gloves they will be spotless.



If you want to ask the pilot questions when you travel by airplane from London to Paris, write him a note

He Knows How to Play with Fire

ALMOST anyone will tell you when ignited—anyone but Cincinnati, Ohio. He correctly maintains that it is only the gasoline vapor that explodes when mixed with the right amount of air; gasoline itself simply burns like oil. As long as you don't let the gasoline mix freely with air for any length of time it will remain quite harmless.

To demonstrate this, Mr. Stubbers pours gasoline from one can to another, and touches a lighted match to the stream as it flows. It bursts into flames, but it does not explode. Then again he will light a match, take the lid off a full can of gasoline, and sink the match into it. It will actually sputter and go out as if the gasoline were water. You see, no vapor had a chance to accumulate. Another one of Mr. Stubbers' pet tricks is to set a can of gasoline on fire, and then blow into the spout of the can. The gasoline will flame up like a torch.

On the other hand, he will pour ten drops of gasoline into a can and let it stand for an hour or so. Then he will approach it with a match at the end of a ten-foot pole. *Bang!* The vapor explodes.

Mr. Stubbers is a gasoline expert and knows how to handle the stuff.

that gasoline explodes Joseph Stubbers, of

(Right) Safe as long as the gasoline fumes do not mix with the air



He touches a lighted match to the stream! It does not explode, because the vapor had no time to accumulate—gasoline burns like oil

Slipping a Note to the Pilot

"HOME, James!" says the man in the limousine, holding a speaking-tube close to his mouth. James, the driver, hears and obeys. But this means of communication won't work in a passenger airplane. The pilot has his ears covered to keep out the cold wind; besides, the noise of the motor would drown speech.

In the airplanes that make daily trips between Paris and London, the pilot and passengers communicate with each other by passing notes through an opening in the side wall of the cabin.

"How fast are we going?" writes a nervous passenger. A few minutes later the hand of the pilot comes through the opening with a reassuring note.

High Cost of War

THE cost of war has gone up even more rapidly than the cost of living. To win our independence cost us \$18.88 per capita; the War of 1812 took only \$14.64 from the pocket of each citizen; the scrap with Mexico cost a mere \$2.48 per capita; the Civil War raised it to \$81.58 per capita; while the World War, though the United States was in it a shorter time than its participation in previous wars, cost us \$236 per capita.

The cost of war for the United States rose from \$76,000,000 for the Revolution to \$18,000,000,000 for the World War.

Newest Automotive Ideas:

The 1920 automobile new accessories that



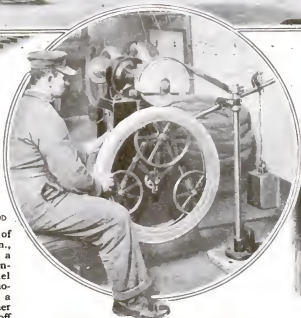
Driving at night would be made safer if the motorist would wear this new electric light on the back of his signaling hand



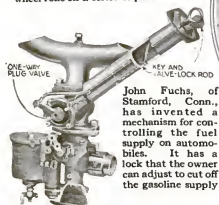
Tube-flanging was formerly a difficult job. Now the special pliers shown here hold the tube, while a turn of the screw at the jaws quickly does the flanging



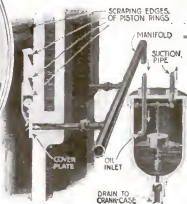
This tractor wheel is really a self-laying track. The wheel rolls on a series of pads



A spider-like device having three outspread wheels over which the tire is mounted permits the operator to rotate the unfinished tire under the grinding wheel and to tone down its tread



John Fuchs, of Stamford, Conn., has invented a mechanism for controlling the fuel supply on automobiles. It has a lock that the owner can adjust to cut off the gasoline supply



For keeping the engine lubricant in its place this invention embodies a specially designed piston and a separating chamber which purifies the oil before it is returned to the crank-case bottom



This small motor-driven cultivator, controlled from the handles, tills corners inaccessible to horse-drawn implements

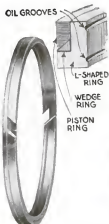


Pneumatic tires on a motor-truck are not new, but a farm truck so equipped is not only new, but practical and economical. Its owner doubled his running time and reduced running expenses

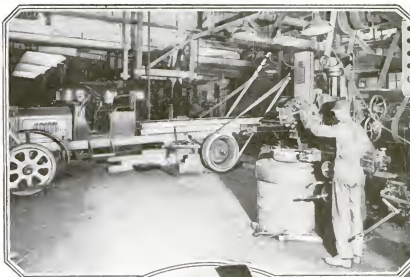
from Signals to Tractors

shows exhibited many will promote economy

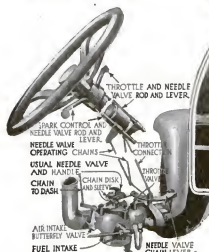
Power was short. The situation was acute. Necessity required invention, and by using the trucks themselves the problem was solved



This piston ring prevents leakage by a triangular-shaped wedge ring interposed between the two main parts of the ring



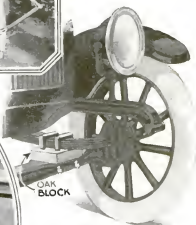
Here is a one-piece honey-comb radiator. No soldered joints enter into its construction, which is effected by electro-deposition



A carburetor attachment that allows adjustment of the needle valve while driving



This metal attachment makes the car driver immune to the headlights of an oncoming car, besides enabling the other fellow to have right road illumination



Springs break in even the best automobiles, and usually the newly fitted spring is stiffer than the others. A block of wood clamped under the old spring in the manner shown brings the car back to an even keel



For hauling milk a specially built glass-lined steel tank of 900-gallon capacity on a five-ton truck chassis has been built. In principle it is simply a giant vacuum bottle and keeps the milk cool even in the hottest weather



He enjoys all the comforts of the enclosed car; the idea embodies a cab built around the driving compartment



In Alaska reindeer are being raised for meat; a herd doubles itself in three years, making the business very profitable

This baby reindeer will soon be branded—not with a branding-iron, but with an aluminum button fastened in its ear



We'll Soon Be Eating Reindeer

A LARGE shipment of frozen reindeer recently arrived at Seattle from Alaska. The United States began raising reindeer in Alaska twenty-five years ago. As they increased they were given over to the natives under the supervision of the Bureau of Education. From a few hundred head imported from Siberia, there are now about 200,000 reindeer in the northern territory, valued at \$6,000,000. They double every three years, though many of them are slaughtered for home consumption.

Reindeer cannot be branded like cattle, because their hair is very thick and is shed every year. When the reindeer calf is a few weeks old, an aluminum button about the size of a ten-cent piece, bearing the mark of the owner, is fastened into its ear, and every deer-owner has his mark or number on the tag. White men have recently gone into the business of raising reindeer in Alaska. They will improve the stock, and if possible breed off the horns. At present the large horns of the reindeer take much of the animal's vitality.

The horns are used for making knife handles, but the production of meat is more essential at present.

Canada is also going into the reindeer business. The great territory lying north of the agricultural belt is to be made a vast reindeer pasture. White moss is the principal food of the reindeer.

It is estimated that Alaska and northern Canada together have a grazing area of reindeer feed for 40,000,000 reindeer. The country is of tremendous extent, and has the advantage of being a natural refrigerator for at least seven months out of the year.

Off with His Head!

BEHOLD the Lord High Executioner! She is shown here all ready to behead a chicken—not with an ax, but with a small-sized guillotine invented by Mr. Frank S. Reece, of Dallas, Tex. The chicken's head is fitted into a groove. Press down quickly on a handle at the top of the device, and down comes a sharp blade and off comes

the chicken's head. Then the handle springs back to its original position.

Mr. Reece considers his invention especially adaptable for use by women, who he says are not usually skilled in chicken-killing.

The guillotine method seems to us more accurate and humane than the ax method.



A miniature guillotine has been invented for killing chickens. All you do is press on a handle, and a sharp blade beheads the fowl

Machining a Monster Propeller

THE United States ship *Leviathan* is the biggest ship afloat at the present time, and its screw propellers are of correspondingly monstrous dimensions. Casting and finishing so gigantic an object is no child's play and requires machinery equally gigantic in size.

The accompanying picture shows the extension boring and turning machine in the Philadelphia shops of a prominent ship and engine building firm. On the table ready for the process of machining, is one of the *Leviathan's* monster propellers.

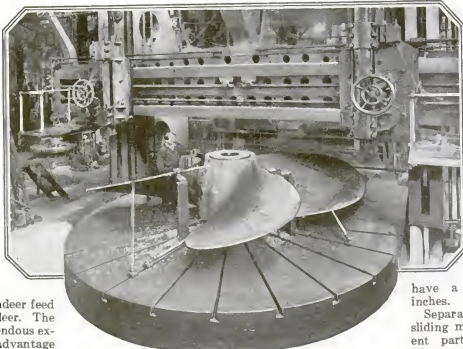
The "table" on which the propeller is fastened is far from

being an ordinary table. It has a diameter of 16½ feet and a weight of 41,000 pounds. It turns on a spindle 26 inches in diameter and will carry a weight of 300,000 pounds.

The tool-bearing arm of this monster machine weighs 35,000 pounds and has a maximum swing of 33 feet 4 inches and a maximal height under the tool-holders of 15 feet 2 inches. The boring bars

have a down feed of 84 inches.

Separate motors control the sliding motions of the different parts of the machine. The main drive is accomplished by means of a 50-horsepower motor.



Compare the size of the man on the farther side of the turntable with the size of the propeller to get a clear idea of the enormous size of the machine described above

Here Is a Perfect Woman



This is Miss Rosalind Smith, of Los Angeles, famed because of her perfect figure. She sleeps nine hours daily and doesn't eat candy, cake, or pastry

VENUS de Milo has a rival, Miss Rosalind Smith of Los Angeles. In fact, Miss Smith outclasses Miss Venus in being able to exhibit two perfect arms.

Here are the measurements of the Los Angeles entrant in the perfect figure contest that is always going on: weight, 121 pounds; height, 63.5 inches; arm reach, 64.8 inches; breadth of shoulders, 14.7 inches; depth of chest, 7.5 inches; girth of neck, 12.3 inches; girth of waist, 25 inches; girth of thigh, 21.7 inches; girth of right calf, 13.1 inches.

Miss Smith says that her perfect figure is due to nine hours sleep each night outdoors, deep breathing, light exercise, and the foregoing of candy, cake, and pastry. Women's magazines, please copy.

The engine of the truck turns a drum, winds a cable, and pulls the logs up



The Truck that Does Its Own Log-Loading

ONE man can hoist a load of logs upon a truck with the greatest ease if he possesses a log-loading device like the one recently invented by Reginald Foster, of Hot Springs, Ark.

The loader is a mass of chains, gears, pinions, joints, shafts, a clutch, a brake, and a drum.

Power from the motor is imparted through the transmission to a drum, which thereupon revolves. A cable attached to the drum has at its other end the chains that are looped around the logs. When the drum revolves, the cable winds around it, and the logs come up the inclined plane on to the platform of the truck. The clutch is then disengaged and the chains are released and sent down the incline for more logs.

If, on the way up the incline, the logs should turn and refuse to roll properly, the clutch and brake could be applied, and the logs straightened and started on their way again.



The traveling butcher shop is the latest plan for fighting the high cost of living; the butcher pays no rent

Pork Chops for Sale!

"STRAWBERRIES!" "Umbrellas to mend!" Added to these street cries you may soon hear, "Pork chops for sale!" One butcher found it cheaper to buy a large truck than to pay the high rent asked for his store and now he peddles his meat.

He turned the front part of his truck into an icebox and the rear part into a counter. Every morning he motors to market, getting back in time to start over his route at nine o'clock. In the course of a day he covers a distance of about six miles. Not only does he escape high rent, but he needs no delivery boy. And his customers are saved the trouble of going after their meat.

He Wears His Family History on the Roof

"HOW many wives have you?"

If you asked a native of Kamerun this question, he would simply point proudly to the roof of his house. There you would see two or three heads impaled—not real ones, we hasten to explain.

Every time he acquires a new wife or child, he puts up a head—a large one for a wife and a small one for a child. At the end of the line-up there is a specially large head to represent himself.

How simple is the task of the husband-hunting girl in Kamerun. When she sees a man she likes, she follows him home and gives his roof a hasty but comprehensive inspection. If there are too many wifely heads already there, she wastes no more time on him.



© International Film Service

The heads on the roof of a Kamerun citizen represent, not victims, but wives and children. He adds a new head for every new member of his family; there's also a big one for himself

An Early Bureau of Standards



If you don't like a wrist-watch, try a belt-watch; it is just as convenient and the women don't wear them—yet

Now the Belt-Watch

THERE'S no denying the fact that wrist-watches are handy, but there are still many men who fight shy of wearing them, because women also wear them. Such men will be glad to hear of the belt-watch, for men only.

A loop is attached to the back of your watch and you run your belt through the loop, holding the watch upside down when you do it. When you wish to see the time, simply raise your watch up from the bottom.

But doesn't this unnatural upside-down position affect the works of the watch? "No," says one enthusiastic belt-watch wearer; "my watch gained an hour a day when I wore it on my wrist, and now it keeps excellent time."

The swinging of the arms seems to upset a watch more than constantly standing on its head does.

LIKE us, our ancestors bought and ate oats, peas, beans, and barley. And they were just as anxious to get full measure for their money as we are. But they did not have a government bureau to set accurate standards of weight and quantity. What did they do? They went down to the market-place and measured out the grain in great stone measures like those below. Everybody used these measures, and thus they became a "bureau of standards" for the village.

The stone measures in our picture are located in the town of Gruyère, Switzerland, and they are supposed to be the sole survivors of their kind in Europe today.



Centuries ago our ancestors used stone measures like these for measuring out their grain



The deadly fumes that rise as the oxyacetylene torch burns its way into brass do not affect this welder at all

Masks for Welders

DEADLY fumes from an oxyacetylene torch, as it burns its way into brass and melts it, no longer hold terrors for J. A. Hendricks, an expert welder in a Seattle shipbuilding plant. Formerly he used from twelve to fourteen hours for a job that now requires only from six to eight hours.

Hendricks now wears a gas-mask like those used in the war. Without the mask he was forced to recuperate for two days after doing a day's welding.

Hendricks is considered the most skilled welder on the Pacific Coast. To him falls the delicate task of welding the brass tail-shafts on big steel steamships. This operation must be one hundred per cent perfect. Other welding jobs may pass with slight flaws, but not so with the tail-shaft jobs.

Taking Your Good Road Along with You

UNLIKE an automobile, an airplane requires but a small portion of ground smooth enough to run upon, while a seaplane requires only a strip of clear water. Now comes an American invention reviving an idea utilized by the Germans during the war, the invention of a landing gear that enables a flying-boat to come safely and gracefully down upon solid ground.

The new Sperry seaplane is equipped with a collapsible landing gear. This new arrangement was designed to permit it to alight

both on sea and on land, and is an innovation of much importance in the development of the manufacture of seaplanes.



On water or on land, equipped with suitable landing gear of boat or wheels, this Sperry seaplane glides safely down

When one of these flying-boats finds itself high and dry over the land, and must come down for fuel or repairs, or for any other reason, the pilot does not fear crushing his boat on the hard ground. He merely pulls a lever lowering the landing gear, the wheels dropping down beneath the boat.

Then the machine runs along the ground to a graceful stop, like a true amphibian of its kind.

Electrical Slaves of Whistle and Lamp

How an Australian mystified English newspaper men

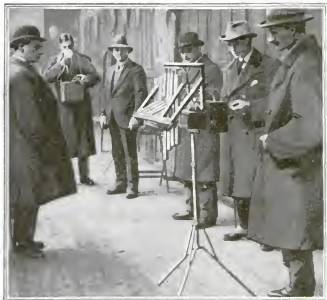
IN a hall near Tottenham Court Road, London, Captain Alan Roberts, an Australian, succeeded in bewildering half a dozen London newspaper men who ought to have known more about elementary electricity than they did. As it was, there was nothing to restrain them from cabling to America the news that Captain Roberts has invented an unheard-of piece of mechanism that performs miracles.

Captain Roberts blew a police whistle. A miniature motor-car containing two lay figures stopped and turned in response to the blast. Then Captain Roberts played a ray of light upon the motor-car. The mustache of one of the lay figures twitched in a very lifelike way. At the same time chimers were rung by an instrument in the corner. A newspaper representative amused himself by blowing a whistle at the correct pitch and causing two lamps with electric batteries to flash.

Radio amateurs who read the **POPULAR SCIENCE MONTHLY** will hardly be mystified by these proceedings. They have seen Christian Berger's engaging electric dog, which leaped out of a little kennel when they clapped their hands. They know that a loud sound may so jar a telephone transmitter that it will cause a wave of electric current to flow through the electromagnet, or in some case a relay, and cause the electromagnet or the relay to act. If the jar is great enough to cause the electromagnet

When Captain Alan Roberts blew a police whistle this miniature motor-car, in which two lay figures were seated, ran about, stopped, and turned, controlled merely by sound

© International Film Service Co.



Captain Roberts completely mystified the newspaper men when he made a set of Westminster chimers ring by turning a beam of light upon them. But anyone familiar with selenium (an element which varies in electrical conductivity with the amount of light that falls upon it) knows how it was done

to release a spring or lever, the possibilities are endless.

It is upon this principle that Captain Alan Roberts has built his toy. The police whistle merely affects a telephone transmitter concealed within the motor-car, causing the electromagnet to release the driving mechanism of the car.

As for the experiment with light, that of course recalls the work of John Hays Hammond, Jr., in this country. Everyone knows that selenium changes in electric resistance with the amount of light that falls upon it. John Hays Hammond built an electrical dog propelled by electric mechanism in which selenium was included. When he turned on a pocket flash lamp, the dog would follow the light as unerringly and as instinctively as if it were alive.

Captain Roberts, of course, uses selenium in the same way to produce the effects that made his spectators gasp in astonishment.

It Squeaks But Doesn't Scratch

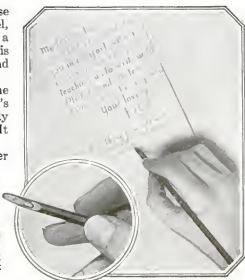
ENGLAND is considering the use of a new pen that is made of steel, quill, or reed, and is cut down to a broad, soft nib. No separate pen is needed. The child inks the nib and writes with it.

The pen moves as smoothly over the page as a paint-brush. As the child's writing improves the nib is gradually cut down until it becomes a point. It may be cut to any angle.

A small metal spring on the under surface of the nib retains much of the ink gathered at the first plunge into the ink-well, and thus a second dipping is not needed for quite a while.

Why didn't we learn with this kind of pen?

Fred is using a reed pen that is cut down to a broad flat writing end, not a point



Breaking Records at the United States Mints

DURING last year the mints of the United States established a new record for speed by turning out 838,911,195 coins for this and foreign governments. This was over 240,000,000 more coins than were minted in the year 1918.

In American money the number of coins was 738,642,000, and their value was \$20,777,000. Included in this coinage were 3,679,000 half dollars, 15,104,000 quarters, 54,529,000 dimes, 76,395,000 five-cent pieces, and 588,935,000 one-cent pieces.

The coinage for foreign countries included 9,440,000 pieces for the Philippines; 10,000,000 pieces for Siam; 3,000,000 pieces for Salvador; 850,000 for Nicaragua; 3,200,000 for Venezuela; and 20,750,000 for Peru.

Were the Good Old Days as More work, longer hours—not many people

Photographs by the



Two, nine, seventeen—the bookkeeper on his high stool used to add up all the long columns of figures on his ledger; if he did not happen to be very alert he usually finished with a difference and had to start all over again



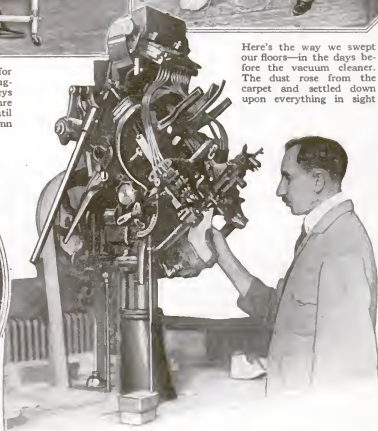
Machines do our adding and subtracting for us now. *Tap, tap—pull.* The adding-machine operator strikes two number keys and pulls a handle. Down comes the figure in black and white. She repeats this until she has come to the end of her column



Here's the way we swept our floors—in the days before the vacuum cleaner. The dust rose from the carpet and settled down upon everything in sight



The shoemaker in his dirty, untidy shop called it a day when he had turned out one pair of shoes. His work was tedious, yet it required skill. He is here sewing the sole to the uppers



Shoes are now made by machinery, one set of machines turning out six hundred pairs a day. This is the machine that does the pulling and nailing of the soles. The man who works the machine learns his job in a very short time and earns as much in a day as the old-time cobbler

Good as They Are Painted?

would really want to go back to them

American Photo Service.

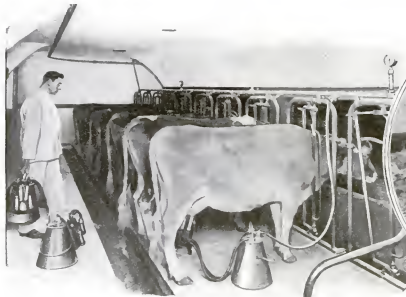


But the vacuum cleaner swallows all the dust it raises out of the carpet; the dust is digested in a large bag, from which it can be emptied at leisure. Dust-caps and bungalow aprons are unknown in the house of the vacuum cleaner; its owner can always be dressed up

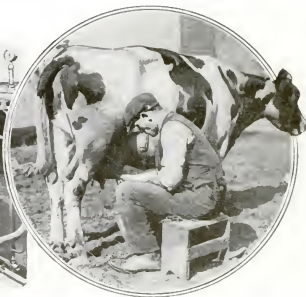
The tailor of today handles fifty suits at a clip. He uses a powerful cutting-machine instead of shears, guiding it by means of a handle. In spite of increased production, the price of a suit has doubled in the last few years



Two by two, the tailor used to cut out your suits; he did it with a pair of long shears. If his hand was steady, your suit fitted well around the neck; but you never could be sure that he wouldn't stay out late the night before he cut into yours



Modern milking is done by machinery. The cows are lined up and held in place by metal bars that fit alongside of their necks. The attendant then attaches the milking machines and the milk is drawn into the pails. They are completely covered and no dust or dirt can get at the milk



The old-time farm-hand smoked as he milked. Both milk and ashes fell into the pail, as well as several inquisitive flies. Perhaps the flies were extracted before you got the milk but they left their germs behind them

Standardized Bodies for Motor-Trucks

THE problems that have held back the more general development of side-dump bodies for motor-trucks in the past included so mounting the body that the contents could be discharged far enough to the side to clear the rear wheels; a low height to permit hand shoveling from the ground; a positive control of the body at the moment of dumping and returning; and the absence of easily damaged mechanism.

These problems have been solved in a new line of standardized bodies, one type of which is shown herewith. They are offered in all sizes, from one yard cubical capacity to five yards, and can be used to carry all kinds of bulk material, such as sand, stone, or cement, or even lumber. Each body of the line is made of steel, is low enough to permit loading by hand from the ground, and may be operated either by a hand-crank or by power from the truck engine.

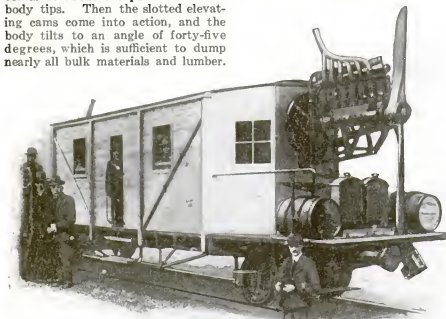
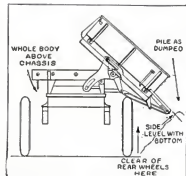
In operation, the body is first carried sideways and slightly elevated on the side opposite the dump until the center of gravity of the load comes at about the point where the body tips. Then the slotted elevating cams come into action, and the body tilts to an angle of forty-five degrees, which is sufficient to dump nearly all bulk materials and lumber.

The side of the body acts as a gate and automatically folds down parallel with the body bottom. In the hand-operated type, twelve turns of the dumping crank will bring the load to the tipping point, and similarly twelve turns in the reverse direction will bring it back again to its normal position.

When it is desired to manipulate the body by the engine power, a chain-driven take-off is provided from the truck gear-set. A safety release prevents damage to the body should it strike an obstruction.

The body mechanism is entirely above the truck-frame, so that no chassis changes are necessary to fit it on practically any make of truck.

Dumping problems for trucks have been solved by a standardized body which, operated by the engine, dumps the load from one side. At the right is shown the dumping apparatus



The hybrid airplane-railway passenger car. Instead of being driven by a locomotive or an electric motor, the new car is run by an airplane propeller, the motive power being an engine whose fuel is benzol

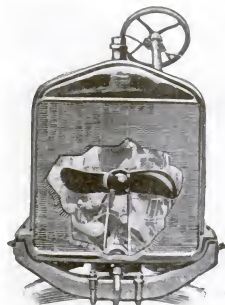
Driving a Passenger Car with Wind

"SOUNDS like an airplane," one might say when he hears the novel railway coach coming down the track. The whirling sound of a propeller cuts the air while the sound of wheels travels down the rails—a strange combination!

During the severe coal shortage in Europe an inventive genius conceived the idea of a powerful gasoline-driven

engine equipped with an airplane propeller, being fitted to a specially built car. The powerful thrusts of the propeller draw in the air, and the car is sent over the rails at a speed of fifty miles an hour.

Forty people can be accommodated in the wind-driven passenger car, enjoying an airplane-like ride safely on the surface of the ground.



The airplane type fan adapted to your Ford concentrates the air currents and whirls them over the engine, thus affording additional cooling

The Two-Bladed Airplane Fan for Automobile Engines

ONE adaptation of airplane engineering experience gained in the war, and now applied to the automobile, is the two-bladed airplane engine fan shown above.

While the old type of fan is so constructed that most of the air currents slip off the blades, the airplane type concentrates the air currents by means of the peculiar spoonlike shape of the blades. The air currents are thus concentrated into a shaft of swiftly moving cool air that bathes the engine, keeping it and the cooling water at the proper temperature.

He Made His Dream of a Noiseless Engine True

By Fred Gilman Jopp

ONE of the early builders of gas-engines was a man with a dream: a noiseless engine. Frank E. Covey, of San Francisco, worked ceaselessly until he produced the object of his dream. His combined reciprocating and turbine engine was designed to get rid of the roar of the exhaust.

In this engine the exhaust, instead of being shot into the open air or through an expensive muffler, is turned on to the rim of the flywheel or runner, into pockets just close enough together to cut the outgoing burnt gases into such small units that after the pocket passes the port there is no more pressure, and therefore no report or noise.

In passing the exhaust port, the

ARE the POPULAR SCIENCE MONTHLY'S prize contests doing good? We'll say they are! Our recent contest, "What Can Be Done with the Exhaust of a Gasoline Engine," discovered, in the invention of the first prize winner, Frank E. Covey, a new light-weight noiseless gasoline engine that will—if its inventor's claims are true—revolutionize the automotive and aeronautical industries. Already it has caused enough stir to induce engineers of foreign countries to investigate.—EDITOR.

force of the exhaust striking into these pockets sends the flywheel at a tremendous speed with no back pressure, since the rim of the flywheel travels so much faster than the reciprocating piston that the flywheel with its pockets becomes a scavenger, allowing no carbon to form anywhere. One reason for this is that no part is dipping in oil to splash more lubricant into the cylinders than necessary, thereby burning up money and burning on carbon.

The fan vanes cast into each side of the flywheel form a double fan blower, which discharges the drawn-in cool air upwardly and directly into the inclined cooling rings of the cylinders. These vanes keep the entire construction cool without water; therefore no radiator, no piping, and no danger of freezing. By closing the air intake the engine can be run as cool or as hot as desired. These are all features that will appeal very strongly to the airplane builder.

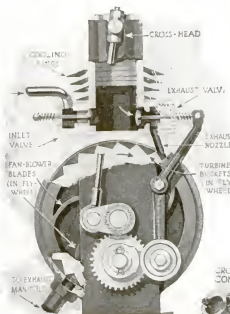
For the airplane, when the

propeller becomes the balance wheel to a great extent, the engine can be built at about one and one quarter pounds to the horsepower, and the amount of weight done away with will cut down the weight of the power plant more than 60 per cent. For more power, an engine of four to six cylinders may be doubled by placing another unit on the same base and connecting the whole to the main shaft. Every moving part can be oiled from the outside through sight-feed lubricators.

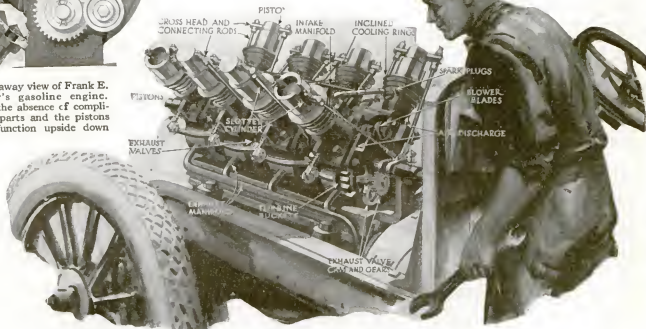
Any piston can be removed without interfering with the others. Should an accident occur to one cylinder, the piston can be disconnected and removed in less than five minutes, and the engine started again without it, with the engine still in perfect balance.

In cost of construction the engine is in a class by itself. So many features absolutely a part of other engines have been found unnecessary in this one that anyone acquainted with the cost of building high-grade machinery will readily see the difference in expense.

In automobile construction, the near future is going to demand a car built on smaller and lighter lines. This noiseless light-weight turbine is here to supply that requirement.



A cut-away view of Frank E. Covey's gasoline engine. Note the absence of complicated parts and the pistons that function upside down



Every moving part can be oiled from the outside through sight-feed lubricators. Should a piston or cylinder become injured, it can be removed in five minutes and the engine operated without it



Let the Wood-Pincher Pile the Wood

WHEN there is a cord of wood to put away, what a saving of time it would be if one's arms could suddenly take on the power of the giant "wood-pincher," developed as a labor-saving device during the stringency of war-times! This mechanical wood-lifting machine is just what the average boy would like to possess when the time comes to pile wood.

Great numbers of tree-trunks to be lifted and moved ordinarily demand the labor of many men. Somewhat on the principle of the "steam shovel," the metal jaws of the huge wood-pincher open above the piles of logs, snap together upon them, and take nearly two hundred logs for a full "bite," then close tightly their iron teeth, and, guided by chains, deposit the logs in place.



Milking the Peanut

DO you like peanut butter? Then you certainly should like peanut milk—and it is much cheaper than cows' milk. A half-cup of peanut kernels will produce a pint of milk that is far richer in fat and protein than is the milk of a cow.

Professor George Carver, of the Tuskegee Institute, in Alabama, conducted the experiments that led to the discovery of peanut milk. He says:

"Whenever you find an animal product you will find its counterpart in some vegetable."

Except for its nutty taste, peanut milk is very like cow's milk. It will sour and curdle, and when churned will produce buttermilk. It may be used in making ice cream, and in flavoring coffee and chocolate.

If not convenient to keep a cow in the back yard, raise peanuts! Cultivate a taste for peanut milk and start a cheap dairy.



Safety First—Out Comes the Fuse

A FUSE-REMOVER that eliminates the danger of a shock when pulling out fuses is the new device of a Waterbury, Conn., man. When a fuse of this type has been in place for a long time it may be rather hard to remove, but with this new device the work becomes simple.

The jaws that grasp the fuses are made of hard fiber, which insures good insulation. The frame is of hard wood. The device is placed so the jaws open around the fuse until the handle is pulled; then the jaws tighten and withdraw the fuse.

Spare the Seed and Spoil the Flax

IN Europe seeds are removed from flax by hand in order to preserve both seed and fiber. But this method is too slow for the American flax-grower: he does it by machinery. The flax is held between two rotating rollers and the seeds are forced out. They fall down a chute directly behind the rollers, and the straw is withdrawn intact.

Flax has been called the most valuable plant that is grown because of the diversity of its uses. From the straw is derived the linen fiber from which all linen goods is made, from the coarsest materials for upholstery purposes, to the finest table linen.

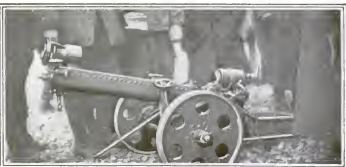
Linseed oil is pressed from the seed, and this is the chief ingredient of paint, linoleums, and oil-cloths. From the solid mass that is left after the oil is extracted, oil cake, which is a valuable stock food, is manufactured. Oil cake is also used in the manufacture of fertilizer.

This New Field-Gun Burst on Test

RECENTLY a new type of field-gun just designed was fired at one of the army proving stations, with the result shown in the photograph. The piece was first tested for strength by firing an extra heavy charge. As the gun passed this test satisfactorily it was considered safe, and the board of officers who were conducting the test crowded around to watch the firing. On about the fifth shot the gun exploded, hurling pieces in all directions, and leaving only the carriage intact.

The piece of metal held by one of the spectators is part of the gun barrel. Pieces of this character were hurled among the bystanders, but fortunately there were no casualties, though one officer had his overcoat cut by a fragment. Experts who examined the wreckage attribute the accident to a flaw in the metal.

Why the gun didn't burst on the high-pressure proof charge instead of on a low-pressure shot will probably never be explained.





Heating Rivets in a New Way

THE man who stands upon a steel girder overhanging a dizzy street-chasm, and whose job it is to demonstrate his ability to toss red-hot rivets to another workman, has more than ordinary interest in the new type of furnace designed for the heating of the rivets.

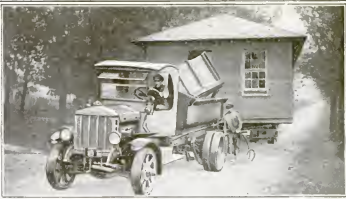
In five minutes he can create in this furnace a temperature of 3000° F., one quarter as hot as the sun. With the flame burning its brightest, he can swing the furnace on a crane and lift it to any position desired. He can keep a number of rivets on the hearth just beyond the play of the intense heat, and in a wink of the eye bring any of them to a glowing temperature merely by raking them under the flame.

Kerosene is the fuel used in the furnace. It is transformed into a gas and blown by compressed air at a pressure of eighty or ninety pounds to the square inch, and the furnace is said to operate on $\frac{1}{4}$ of a gallon an hour. It is claimed that the flame burns without hydrogen and is therefore non-oxidizing, so there is no danger of burning up the rivets or tools left in the heat of the flame.

Removing the Cherry's Pit

CHERRIES may be pitted in the machine shown below in this fashion: First, pluck off the stem and fit the upright cherry in the curved base of the pitting-machine; then press down on the handle and force the pit out through the hole in the center of the base. A spring sends the handle back to its original position.

Owing to the sudden falling off of the cocktail business, however, we fear that many a young cherry will have to go begging in the future.



House-Moving by Motor-Truck

WHILE many New Yorkers pay two hundred dollars a month for a first-class four-room apartment, it is said that in Cincinnati one can buy a four-room house for that price. Not that Cincinnati has anything to do with it. The government built the houses, at a cost of fifteen hundred dollars each, for the workers in munitions plants in the neighborhood.

The munitions workers having gone elsewhere, these houses are now being sold. But they must be removed by their new owners within sixty days. That explains why on the roads leading out from Cincinnati may often be seen great trucks lugging the houses away.

Each of the four-room houses is equipped with electric-light wiring and fixtures, and an excellent bath-room and kitchen, together with the necessary plumbing.



© Kadol & Herbert

He Shoots His Toy Airplane from a Gun

POP! Off goes the gun, and out shoots a toy airplane. It travels gracefully through the air for about two hundred feet and then drops gently to the earth.

The gun is made like an air rifle, except that there is a slit in it running from the trigger to the nozzle. And inside there is a strong spring attached to a small catch that slides back and forth through the slit.

The boy attaches the tail of the airplane to the catch and drags the airplane down toward the trigger. The spring contracts and is caught by the trigger. After he has aimed the gun he pulls the trigger. This releases a spring and the airplane shoots off.

Since the toy is neither gun nor airplane, but a combination of both, it might be called an airplane-gun.

Trying Out the Seeds

IN these days of under-production, the parlor-table seed-tester proves its value.

The tester is provided with a bottom tray, which not only protects the user from dirt and drippings, but which also makes unnecessary any further attention after the first operation.

On the bottom of the tray is a blotter over which there is a pad that holds and supplies the necessary moisture. This pad is perforated with compartments, and in these the seeds to be tested are placed.

The testing is best done in late winter or very early spring, as usually too little time remains to be sure of the quality of the seeds if the gardener waits for the planting season.



Carrying a Monster Gun Under the Sea



© International Film Service Co.

Now that we have peace, doubtless this submarine with a 12-inch gun is prepared to see that we keep it

THE British submarine M-1, which mounts a 12-inch 45-caliber gun, is the most powerful undersea craft in the world, and represents a new idea in naval warfare.

It was completed in August, 1918, just before the end of the war, and was to have been used in convoying merchant ships which might have been attacked by enemy light cruisers. As a matter of fact, the M-1 has never been in action.

This unusual craft is 200 feet long, and has a displacement of 2,000 tons and a speed on the surface of about 16 knots. There is the usual recoil arrangement made for the big gun, but despite this the submarine goes back about ten feet in the water, from the recoil, whenever the gun is fired.

Sunken Ships Lifted with Air-Bags

A METHOD has been devised and successfully tried by which sunken ships can be salvaged with comparative ease. Instead of using heavy steel tanks whose weight must be added to the lifting force employed, the new way is to place fabric bags in the hull of the vessel and inflate them with air. To augment the effect, a number of bags may be attached to the outside of the hull.

The bags are made of very strong rubber water-proof canvas, are from 30 to 40 feet long, and displace from 50 to 100 tons of water.

There is no difficulty in placing them inside the ship's hull. They are flexible and can be folded to fit a small space during transportation, in this respect being very different from the more clumsy steel tanks ordinarily employed.

In order that the compressed air within the bags will not be forced to the bursting-point, each bag is provided with an automatic blow-off valve. When placed in the ship the bags are flat and lie against the girders, and the vessel begins to rise when sufficient air has been blown into the bags.

Since the bags are placed just where the greatest weight is encountered, the ship can be lifted without any severe strain on the structure—a very great advantage over the old method.

The first vessel to be salvaged by this system was the steamer *Main*, which had been sunk by a German submarine in Luce Bay, off the coast of Scotland. The bags displaced one hundred tons of water each, and weighed only one ton complete.

Larger bags are being made, and it is rumored that the *Lusitania* may be raised from the bed of the ocean by this system of air-inflated bags.

It Is Midsummer Now in Northern Mars

SEEN through a telescope, the bright planet which everyone notices in the east after sunset appears as an exceedingly interesting object. It is Mars, the mystery world.

Just now the earth observers see Mars in the height of its northern midsummer. The polar snow-cap has melted to its smallest, and many of the curious dark markings seen upon its yellow deserts and called "canals" have vanished under the sun's persistent rays. In the far southern region of Mars midwinter prevails, and as the planet is observed through the rest of the year the coming of spring in the southern hemisphere will be witnessed.

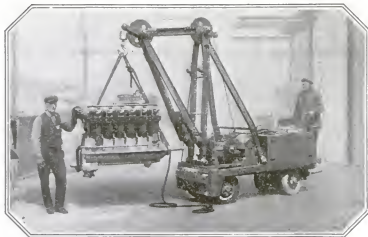
It is strange to look across the gap of more than 50,000,000 miles and see the changing seasons displayed upon another world! On April 21 Mars will be in opposition and on the 27th it will be closest to the earth.

The distance of Mars from the earth at the present time, is about 15,000,000 miles greater than it is possible for the planet to approach, but it is closer than during the opposition of 1918.



Perhaps the *Lusitania* will be raised by air-inflated bags. The bags are placed in the ship flat; when they are inflated with air, the ship rises

Let the Truck Lift It



An electric truck equipped as a crane. It is here shown in a position for hoisting heavy objects, the hoisting structure having been unlatched and drawn down the vertical bars

TEN men tugging at a 4,000-pound weight may finally be able to move it to the desired spot; but the work of all ten can be done very expeditiously with one of the new crane-trucks. Easily the electrically driven truck travels over to the pile of heavy machinery, extends its sinewy arms, picks up the massive weight, and swings it around in the most cramped quarters of a storage room, setting it down in the exact spot intended for stacking. At the present high cost of labor, one can imagine the expense of employing men to do the work that this clever piece of mechanism can do.

The truck has a two-wheel drive and a four-wheel steer equipment, and is capable of being made into a four-wheel steer truck. The cost of operation varies, of course, with the facilities for charging the batteries, but under normal conditions the crane-truck can be operated for one hour, moving a load of 4,000 pounds, at a cost of about ten cents, including the operations of starting and stopping.

A Bath-Tub for Sun-Baths

FOR certain skin diseases the curative power of sunlight has long been recognized, and many people who have availed themselves of no stronger remedy than sun-baths have been restored to health. Realizing this, an enterprising doctor of Brittany has constructed a special type of bath-house. It is designed to collect the sunlight even when the sun is low and its light weak.

A lens is arranged to follow the motion of the sun, and to concentrate the rays upon the patient, who is hidden from view in the bath-cabin. The cabin itself revolves and the lens brings the rays to bear upon any part of the body desired.



© American Photo Service

He owns his home; it's a trolley car. The kitchen is out in the motorman's box, and the other rooms are curtained off inside

She's a Dog-Catcher

NEXT time you pick up a stray dog or cat and send for the wagon to take it away, don't be surprised, when you hear the dog-catcher's wagon, if a woman jumps from the front seat, runs up the steps, and rings your door-bell.

During the war the shortage of men dog-catchers in American cities made it necessary to hire women to take their places.

In the picture below you see Mrs. Laura Dietrich, one of Denver's dog-catchers, putting a poor little stray pup into a pen. The pens in the pound are quite desirable from a dog's point of view. There is a clean, comfortable bed in each pen, and even a chair for visitors.

Lost dogs and dogs that never in all their lives had any owner are placed side by side. If, within a certain length of time, no one claims or asks for any dog in the pound, alas! he is killed.



In the shortage of men dog-catchers brought about by the war women came to the rescue. Here is one of Denver's dog-catchers putting one of the pups in his pen

Home, Sweet Home—This Time It's a Trolley Car

AND the landlord raised the rent again! But Thomas O'Mara refused to pay it. He took his rent money, bought an old trolley car with it, and made the trolley his home.

The motorman's box is now a kitchenette, and the inside doors of the car will shut out the fumes when Mrs. O'Mara cooks corned beef and cabbage. The seats along one side continue to serve as seats, but those on the other side are used to support the table and beds. The car is curtained off into separate rooms. There are windows all around, plenty of fresh air, sunshine—and no rent to pay! What could mortal wish for more?

We do not know where Mr. O'Mara keeps his trolley car, but probably a kind-hearted neighbor offered his side yard.

Things New for All the Members of the Household



When cleaning house, put birdie in the yard



Attach this sponge-dryer beneath your soap-dish

Why not introduce some of these labor-savers?

An armful of small bundles that are always slipping is no longer necessary, now that many grocers supply their customers with heavy wrapping-paper shopping-bags that have strong cord handles



You are tempted to buy more when you can carry the things so easily

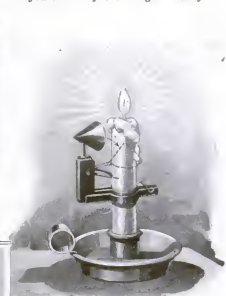


Pour some paraffin in a glass, sink into it a wire cage containing absorbent cotton and a wick, and use for a night-light



© Press Illustrating Service

Replace the bristles in an old shaving-brush with a small sponge: it takes readily to lather



You can leave this candle lighted. When it has burned low, the snuffer will drop automatically



This broom's Japanese inventor claims that the joint enables the user to dig in corners conveniently



"Bake in a hot oven," says your recipe, and you turn up the gas. But how can you be sure that your oven won't get too hot? Use this automatic temperature regulator

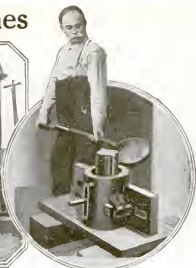


A German preserving outfit provides a water-jacket with a steam cover. The jars are easily handled

Do It with Tools and Machines



The portable belt conveyor has found a wide range of usefulness in loading and unloading cars and trucks and in storing material such as coal, coke, sand, and gravel



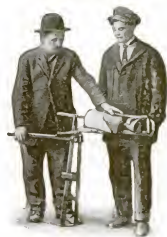
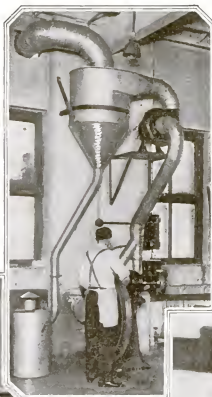
The purpose of this apparatus is to mold into shape the babbitt metal bearings that are used in shaft-hangers and journal-boxes

It is a portable outdoor lighting apparatus, which weighs only forty pounds, producing a powerful white light at low cost

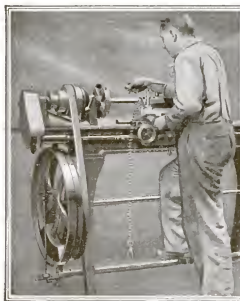


This ammeter affords the only means of testing the condition of a dry-cell. Contact may be made directly to the battery

(Right) Emery wheels partly covered with a hood, which catches the dust from the tire casing and then draws it off through a blower

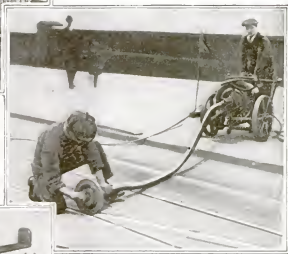


In manufacturing boots, those made with the so-called friction lining stick to the lasts. A portable boot-stripping machine removes them quickly and easily



The foot treadle of this lathe runs the entire length of its frame, thus permitting convenient operation from any position. Tool-rest and tail-stock have unusually large bearing surfaces which insure great rigidity and accuracy

(Below) Useful alike to the farmer, motorist, and home mechanic is the six-in-one tool combining a vise, an anvil, an emery and buffing wheel, a drill, and a pipe vise. It weighs only ninety pounds



Car rails were formerly ground by hand, a long and tedious operation. Now the big traction companies supply their men with an electric motor which drives a flexible shaft attached to a rotary grinder

She's Made of Wood and a Thousand Wheels

PYGMALION made a statue, loved it, and it came to life for a short time. But that happened centuries ago. Dr. Nixon, of San Francisco, has built a statue answering to the name of Isis. She reclines on a divan, gorgeously clothed, and spends most of her time playing on a zither. She knows sixty-four tunes.

There is no gray matter in her pretty brown head—just wheels, a compass, and bottles of colored liquid. In her bosom are more than three hundred wheels, and in her entire body more than a thousand. She is a mechanical masterpiece. Dr. Nixon has spent twelve years putting her together and he says she can do nearly everything but speak.

Isis, an image carved by the man at her side, can play sixty-four tunes on her zither

© International Film Service Co.



In a sudden shower, a protector made of adjustable bars and canvas is quickly erected on the bus-top

Caught in the Rain

YOU are sitting on top of a bus, enjoying an early warm spring day, when a sudden shower comes down. What happens if you can't find a seat inside?

But buses may soon be equipped with rain-protectors like the one shown above. In fair weather, the protector slides into place beside the seat and is hardly noticeable. It is simply a combination of jointed metal bars and rolled-up canvas.

When it rains the bars are extended, the canvas unrolled, and the seat will be well protected at front and side from the rain. Since the bus moves forward, there is no need of protecting the back of the seats. And the side toward the aisle is left open, so that passengers can get out without trouble.



Safeguard the Children by Foot-Printing Them

ARE you afraid your child will be kidnapped? Have the boy foot-printed! Thus has the Bertillon system of finger-printing criminals been expanded and the new method of identification been made to apply to lost children who are too small to give the police any information about themselves. The method also is serviceable in maternity hospitals, where the matter of identification of children might become complicated.

Anxious mothers who fear their children might be lost or kidnapped may take them to the police station to have foot-prints made. Examine the skin of your hand under a magnifying-glass and you will see many ridges and furrows. No two people are provided by nature with similar finger- or foot-prints in the matter of pattern or minute details in the ridges where the perspiration glands have their openings. "By their foot-prints ye shall know them," might be an adaptation of the old saying, the little ridges of hands and feet providing the only absolute means of identification known.

The Chinese were pioneers in recog-

nizing the value of the finger-print as a means of preventing forgeries. When a will was read to the beneficiaries, their approval was attested by their

finger-prints attached to the document. A finger-print beside the signature on a check would make forgery of the writer's name an impossibility.



Foot-print of a twenty-months-old boy. The police could pick him out of any number of lost children



Foot-printing a boy for identification if he should be lost or kidnapped. The child's foot is brought in contact with a surface evenly inked, and it is then evenly impressed upon a sheet of paper. The ridges in the skin on the bottom of the foot furnish unmistakable details of identification

Fumigating a Sick Tree

A balloon drops a tent over it and the deadly parasite-killing fumes are released

By P. Schwarzbach

WHEN you emerged from the measles your room was fumigated so that the rest of your family wouldn't catch 'em. Just so, when part of a tree becomes diseased, the other trees are also fumigated so that they won't catch diseases.

But fumigating rooms and fumigating trees are vastly different jobs. By closing the door you can shut off a room, but in order to fumigate a tree you must put a tent around it to shut it off from its neighbors.

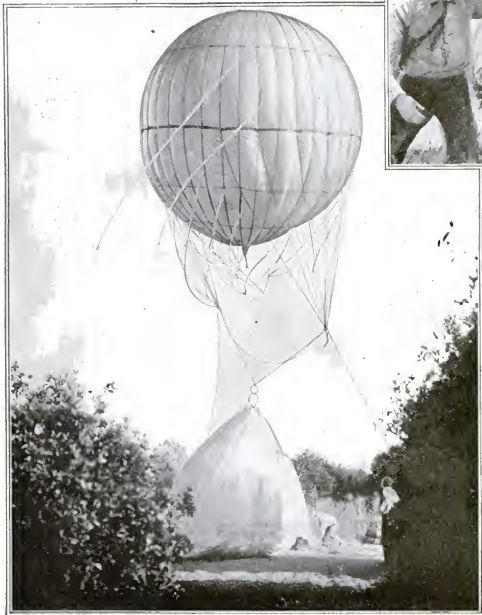
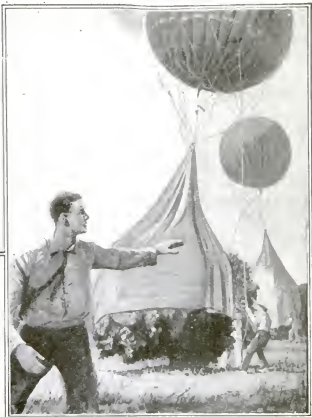
What is the quickest, easi-

est, and best way of accomplishing this?

Mack Swain, of Los Angeles, will tell you to drop a tent over the tree by means of a captive balloon.

Perhaps you have heard of Mack Swain. He is a well known slap-stick moving-picture comedian. He has recently patented his idea of fumigating by balloon.

The tent is hooked to the balloon, which is moved until it is directly over the tree. Then the balloon is lowered. The tent opens like a parachute, and settles comfortably



Insects were ruining a fruit tree, and the owner decided to fumigate it. A captive balloon with a tent hooked to it was brought directly over the tree and lowered. The tent opened up like a parachute and settled over the tree

The tent was fastened into place and then deadly fumes were released inside of it; the insects and their eggs were quickly killed, whereupon the balloon carried its tent away

over the tree. The balloon is then unhooked and starts back for another tent for another tree, while the tent it left behind is fastened to the ground.

Hydrocyanic acid does the fumigating. It is a deadly volatile poison, and as it fumes away it kills all the insects on the tree, and even the insects' eggs. This acid is also known as Prussic acid. It has the seductive odor of peach blossoms.

When the tent is securely fastened, the tanks of hydrocyanic acid are shoved underneath it and opened. After the fumes have done their deadly work the balloon is brought back to the scene of action, the tent is hooked on again, and away the balloon goes to another tree.

Mack Swain, the inventor of this device, is not the only moving-picture comedian who is interested in it; for Chester Conklin, who spends his working hours trying to dodge pies, dough, and soft tomatoes, has bought a forty per cent interest in the patent.

Buzz-z-z—You Forgot the Light

It Tells the Time in Words

DID you ever hear the story of the man who left an electric light burning on the day he started on a trip around the world? When he returned it was still burning—and he had to pay his house to pay the bill.

There has recently been invented a switch that makes it almost impossible to forget to turn out the light. It is intended primarily for cellar, attic, and closet lights, although it is equally serviceable elsewhere.

As soon as the light is turned on, a gentle buzzing begins, continuing until the current is switched off. The device, which is merely a combination of an ordinary snap switch and an alternating-current buzzer, is easily installed and soon pays for itself.



From the minute you turn on this switch till you turn it off, its partner will buzz



Here is the mechanism, showing the strip of film upon which is recorded the voice that announces the hours. The horn projects the sound upward

In about five minutes, when this clock speaks the quarter-hour, everyone in the room will start

"THREE o'clock!" This clock does not strike. It speaks and tells you the hour and even the quarter-hours. Such is the marvel of an English clockmaker.

The mechanism of the clock is connected with a film on which has been recorded the human voice. The film moves so that a phonographic arrangement connected with a horn operates when the hour or one of its quarters is to be announced.

In the ordinary phonograph the stylus, or "needle," travels around the grooves of a cylinder or disk upon which the sound waves have been recorded. In the speaking clock the needle is stationary, resting upon a strip of film, which travels over a drum, and with slight latitudinal motion it follows the oscillations of the sound waves recorded upon the film.

The Postman Brought This Wall-Paper

FATHER BUCCI, a Californian, has papered a room with 105,000 stamps coming from thirty-five nations. Three designs compose the walls: one from ceiling to picture-molding, one from picture-molding to chair-level, and another design from the chair-level to the floor. The design includes the American and Italian flags, all in stamps.

It took Father Bucci about ten years to collect the stamps, and another six months to arrange them.



Pasted on cloth so it can be removed, this wall-paper represents ten years of stamp-collecting

Outdoor Moving-Picture Shows

"HERE come the movies!" This is the shout of the children in country villages when they see a certain motor-truck coming down the road. Indeed, traveling movies are now common in Europe, because daylight is no longer an obstacle to outdoor shows.

The invention that made this possible is based upon the construction of a screen which absorbs the rays falling upon it while transmitting the rays from the other side.

With such a screen, all that is required is to keep the light from the outside

from mixing with the light of the image on the side from which it is projected. This is done by enclosing the projecting apparatus in a light-tight compartment. The invention lends itself to many applications.



Here is the traveling "movie," showing a picture in full daylight as it appears on the side of the truck



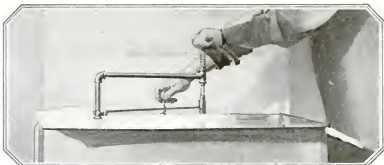
Showing a moving picture on the wall of a room in broad daylight

It Simplifies the Cutting of Circles in Glass

HAVE you ever tried to cut a circle out of a plate of glass, and if so how did you succeed? The surface of the material is so smooth that, even if your glass-cutter were fixed to a compass, it would not enable you to cut a clean circle unless a special arrangement were made on the order of an interesting invention that has just been patented.

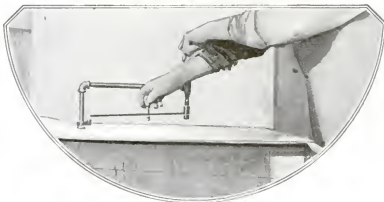
The operation of the device is simple. The plate of glass to be cut is laid on a table and the upright standard of the cutter is securely fastened. An arm extends from this standard, terminating in another upright tubular standard from which extends a bar bearing a scale in half-inches.

The glass-cutter is attached to this bar, and rotates around the second standard, which is clamped down by the little spindle-head on top of a strong spring. If



The left hand turns a spindle-head, which clamps the standard down upon the plate of glass, while the right hand adjusts the position of the glass-cutter

The right hand now prepares to swing the cutter around the standard to sweep out the circle. By this new device you can cut glass quickly and accurately



the circle is to be six inches in diameter the cutter is slid outward on the bar three inches along the scale, and with a sweep of the hand the glass can be quickly and accurately cut.

Decisive action, the accurate sweep of the hand, and the right pressure are demanded of the glass-cutter if he would make a perfect "cut."

The mechanical arrangement of the compass enables one to give just the right pressure bearing upon the glass while he sweeps out the circle. The device being clamped to the table in a fixed relation to the position of the sheet of glass makes it possible to cut duplicate circles with the utmost economy.

Every circle will come from the same portion of each plate or sheet, and there will be no haphazard guesswork, resulting in loss of material.

When Coal is Short Run the Factory with Tractors



During the recent coal famine, when government regulations would have reduced the working hours and put many employees in idleness, at least one enterprising manufacturer succeeded in overcoming the difficulty. With gas engines and a steam road-roller, sufficient power was generated to keep the wheels



of industry turning. Outside the factory building the heavy road-roller did the work of the electric motors. Inside the building the gas engines did their duty, keeping the machines busy. Several tractors were also used to drive generators, and these furnished electricity for lighting the entire plant

Hitting the Moon with a Rocket

Professor Goddard of Clark College plans to fire off a cracker right under the nose of the man in the moon

By E. F. Richards

A FEW months ago the plausibility of reaching the moon was considered in these pages on the basis of some calculations made by the French aeronautical engineer Robert Esnault-Pelterie, who showed that the most compact explosive known did not carry within itself sufficient energy to convey it to the moon by its own power.

Now Professor Goddard of Clark College, Worcester, Mass., comes forward with computations and experiments that cast an entirely new light upon the situation. In the first place, it is to be observed that, in order to reach the moon, it is not necessary that the explosive employed should possess sufficient energy to carry the whole of its weight to our satellite. For, as a rocket proceeds on its course, it continually discharges a part of its mass, so that only a fraction is carried the whole distance.

Secondly,—and this is where the significance of the recent computations and experiments appears,—it has been found by calculation that the velocity of the gases issuing from the rocket, by which velocity the kick is produced, has an extraordinarily great influence upon the amount of explosive required. Professor Goddard has succeeded, in his experiments, in raising the velocity of the gases discharged by the rocket from 1,000 feet a second, the best performance of ships' rockets now on the market, to 7,000 feet a second. The best rifle hurls its bullet out of the barrel with an initial velocity of less than 3,000 feet a second.

The full significance of this can be appreciated only when we consider some actual figures. So, for example, Professor Goddard's computations show that in order to kick one pound from the earth to the moon requires, under the most favorable circumstances, an explosive charge of 602 pounds. This is assuming a velocity of 7,000 feet a second for the gases discharged by the rocket. But if we were restricted to a velocity of 1,000

feet a second, as in the ships' rocket, the charge required, per pound carried to the moon, would be the seventh power of 602—that is to say, 14,290 million million tons!

It will thus be seen that Professor Goddard's improvement in the design of the sky-rocket has, at a single step,

Professor Goddard has not only worked out the problem on paper: he has conducted experiments to furnish the experimental data required.

It would, of course, be impossible to follow the course of such a small body through the 240,000 miles that separate us from the moon. But the rocket could be made to carry a charge of flash-powder arranged to go off when it hit the moon's dark surface, the event being brought off about the time of new moon. And the amount of flash-powder required can be easily determined by a simple experiment. Professor Goddard found that one fifth of a grain of powder made a flash plainly visible at a distance of two and one fourth miles. To

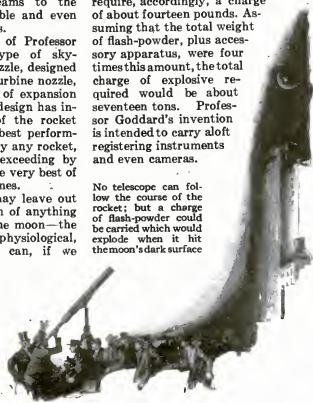
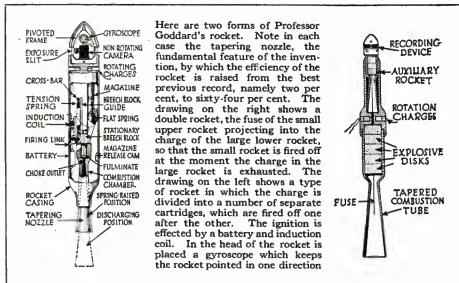
transferred the enterprise of hurling a missile to the moon from the class of utterly impractical dreams to the domain of entirely feasible and even comparatively light tasks.

The principal feature of Professor Goddard's improved type of sky-rocket is the tapering nozzle, designed on the principle of the turbine nozzle, so as to utilize the work of expansion of the hot gases. This design has increased the efficiency of the rocket from two per cent, the best performance attained hitherto by any rocket, to sixty-four per cent, exceeding by far the record of even the very best of internal-combustion engines.

For the present we may leave out of consideration the plan of anything like a personal visit to the moon—the chief difficulties here are physiological, not physical. But we can, if we want to, reach out a long arm and tickle the moon, as it were. Here a new problem arises. Suppose we send a rocket to the moon. How shall we know whether our aim has been true and the shaft has gone home? Pro-

produce an equally visible effect at the distance of the moon would require, accordingly, a charge of about fourteen pounds. Assuming that the total weight of flash-powder, plus accessory apparatus, were four times this amount, the total charge of explosive required would be about seventeen tons. Professor Goddard's invention is intended to carry aloft registering instruments and even cameras.

No telescope can follow the course of the rocket; but a charge of flash-powder could be carried which would explode when it hit the moon's dark surface





To Hit the Moon with a Rocket

Professor Goddard, of Clark College, has invented a rocket that operates on entirely new principles, and that would make it possible to hit the moon. It has been estimated that with ordinary rockets it would take 14,290 million million tons of explosives to reach the moon. Professor Goddard's rocket requires only 602 pounds, because the gases are discharged, not at the usual rate of 1,000 feet a second, but at 7,000 feet. The fastest projectile hurled from a rifle has a velocity of less than

3,000 feet a second, from which it is seen what a marked improvement Professor Goddard has made. The total charge of explosive required to reach the moon would be seventeen tons, equal to the total weight of ammunition discharged by a battleship when it shoots off all its guns at once. In other words, Professor Goddard's improvement at a single step transfers the enterprise of hurling the missile to the moon from the class of impractical dreams to the domain of comparably simple tasks

Spring Cleaning the Automobile for Summer Economy

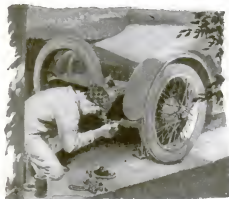
By Fred Gilman Jopp

OUTDOORS nature is dressing field and tree with new style greens. Indoors your wife serves the meals on the kitchen table and clutters up the floor with rolls of carpet—it's mere spring cleaning. Your share is awaiting you, so put on your overalls, go out to the garage, and take the car out of winter storage. It should be gone over at least once a year, to eliminate many of the summer troubles that result from lack of preparedness.

To make a thorough job, it is best to start at the front of the car and work back to the rear axle.

To Find the Leaks

First, disconnect the radiator from the car and take it off. Plug the inlet and outlet holes with wooden blocks. Stand the radiator on the floor and force water into it with a hose. If



It is a simple matter to jack up the wheels of the car and lubricate the four springs. A thorough greasing at this time will eliminate all those annoying squeaks

there are any leaks they will now be visible. Scrape these spots with an old knife and cover them with soldering acid. Then apply the solder with a soldering-iron. Wash out the radiator with a solution of hot water and washing soda, and rinse out with cold water from the hose a few times.

Cover the gasoline line carefully. Disconnect the joints and blow into them with the tire-pump. This will remove any sediment and save a possible stoppage of gasoline later on. Examine the line for leaks. Sometimes dirt works into the carburetor strainer and collects there. Wash it out carefully or it will cause trouble. Drain the old gasoline from the tank; it is no good now except for cleaning purposes, for its strength is gone.



Use the hand crank to determine the engine's compression. You can tell by the "feel" of each cylinder whether the valves need regrinding. If they are ground at this time they will go for a long time in the busy season before they need grinding again. The fine grinding compound is best, since the coarse usually leaves in the valves deep ridges that must be ground out.

Wash the engine carefully after you are through with the grinding operation, or some of the compound will get into the cylinder walls and continue to grind into your expense account. Make sure that there is a clearance between the valve stems and lifters; otherwise the valves will not seat and there will be leakage. When adjusting the lifter, test for clearance after the jam nuts have been tightened, for the tightening of the locks may alter the adjustment.

Taking Your Car in Hand

Serious repairs on the ignition units must be taken to an expert. Don't try to make them yourself. A study of your car's wiring diagram will be valuable at this point, for with it you can trace each wire to its respective

terminal. Inspect the spark-plugs for cracked porcelains; clean and adjust the points that should be spaced the distance of a thin dime apart. Examine the wiring for rotted insulation, taping, and applying new wire when necessary. Clean and tighten all terminals and support-

ing wires that lack proper fastening.

Remove the cover of the ignition distributor, and use a fine flat file to smooth down the points, but *don't* remove more metal than is necessary. Adjust them when you are finished using the gage provided for the purpose.

Carbon brushes that stick can be loosened with a drop of gasoline; weak spring pressure can be increased by pulling the spring apart with the fingers.

The steering wheel play may be taken up in the gears at the bottom of the steering-post. Tighten all knuckles and lubricate carefully. Should anything go wrong here when the car is under way, a bad accident is sure to result.

Drain the transmission and rear axle assembly with two quarts of kerosene to flush out each casing, and refill with a standard lubricant.

Go over the brakes carefully; clean them and fit new clevis pins if necessary. Adjust the brakes by jacking both rear wheels from the floor and allowing the engine to run with the car in high gear. See that both wheels stop the instant the brake is applied.

Lubricate every part as explained in your instruction book.

The differential, axle, and universal joints are difficult to get at, and are therefore often neglected. Get after them now and clean and lubricate each part carefully.

Look over the chasses and body. Tighten all loose bolts and nuts. The front axle rarely needs attention, but if there is too much end play, take off



Most "rattles" on a car are caused by just one thing—loosened nuts and bolts. Make it a point to find and tighten each one individually, then you won't be troubled with squeaks later on



The Thermometer The 100% Efficient Cook

*"My Wife's strawberry jam"
Oh, MAN, what eating!*

WHAT if one jar in a dozen "works." No housewife is a failure because of *that*.

But, suppose a canner putting up thousands of jars of preserves, or baking beans by the million, loses one jar or can in twelve. What would happen? Bankruptcy.

How is it then that your old-fashioned home cook—your idea and mine of the world's best, when it comes to "eats," doesn't show up 100% efficient and the professional canner does?

Temperature Control. That's the answer.

Formerly the housewife had to trust to experience, "guessing," or "looks." But today the canner and increasing thousands of modern housewives, cook by the thermometer—the secret of accurate results.

When a corn canner, for instance, cooks, mechanical arms stir the corn in a huge kettle. A metal rod dips into the kettle too. It's like your finger, that rod. It feels how hot the corn is. It expands and contracts with the slightest drop or rise in temperature and signals back to a valve on a steam pipe. "Turn off the steam," it says if the corn is too hot; or "more heat," if the temperature is falling. And the regulator responds instantly by moving a valve.

That's the principal reason why one can of corn on the grocer's shelf is as good as every other can of the same brand.

In hundreds of the large canneries here and abroad *Teco* Temperature, Indicating, Recording and Controlling Instruments are used. They are regarded as the standard of accuracy just as they are in hundreds of other industries.

There are over 8,000 different kinds of instruments in the *Teco* line. At the left we list *Teco* Instruments for home use. Ask your dealer about them. If he won't supply you, write to us direct sending dealer's name. Literature on any instrument or type of instruments in which you may be interested will be sent you promptly.

Teco Aids To Promoting Health, Comfort and Economy in the Home.

Teco Wall Thermometers

To help you maintain a temperature in your house conducive to good health.

Teco Bath Thermometers

To enable you to get the most good from your bath.

Teco Home Set

Bake Oven Thermometer. Candy Thermometer. Sugar Meter. The secret of accurate results in cooking.

Teco Hygrometer

To enable you to keep the humidity of the atmosphere in your home correct at all times.

Teco Weather Barometers

Forecast the weather twenty-four hours ahead with dependable accuracy.

Teco Quality Compass

To show you the right way in unfamiliar country.

Teco Fever Thermometers

A necessity in every home.

Teco Office Thermometers

An aid in promoting business efficiency.

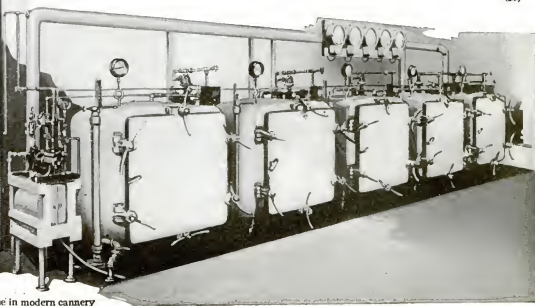
(Ask Your Dealer)

Taylor Instrument Companies

Rochester, N. Y.

There's a *Teco* or *Tyler* Thermometer for every purpose.

(2-7)



Teco Instruments in use in modern cannery

the hub caps and adjust the bearing cones so that the wheels will turn easily without dragging. Fill the caps with grease. This will be forced through the bearings and will thoroughly lubricate them.

If when adjusting the wheels a grinding sound is heard in the bearings, take off the wheel. There may be a broken ball, a scored ball race, or a worn cone. Replace them with new.

Look to Your Storage Battery

Start the engine and note whether the ammeter indicates the proper charge, that the lights are burning properly, and that the storage battery shows a strength of 1.275 at least. If the battery has been left on the car all winter it is ruined, and if it shows no strength or the plates have turned white, take it to a battery station for overhauling. Hold your hand at the bottom of the radiator to see if it gradually grows warmer—this denotes

that the pump is working properly. Pull the throttle wide open quickly to see whether the carburetor needs adjusting. Listen carefully to the engine's sound the first few minutes.

An expert automobile and carriage painter can obtain the real "factory finish," but it's well to know how to do the work yourself and save the money.

When the surface is in good condition and it is desired merely to freshen the colors, clean off all dust, dirt, and grease with benzine or turpentine. Next sandpaper lightly to cut the gloss, and then apply one or two coats of a good automobile finishing varnish.

How to Paint Your Automobile

If it is desired to change the color, first thoroughly clean off all foreign matter with sandpaper, apply two coats of automobile enamel of the desired color, and varnish.

When the surface is in bad condition and the paint has been chipped or

cracked, remove all loose particles and prime such spots with lead and oil primer, composed of lead in oil thinned with turpentine and a little Japan drier. Allow it to dry for twelve hours. Deep cracks and dents should be plugged with filler and knifed on as you would use putty. Allow to dry eight hours, and sandpaper level. To even up the surface, apply one or two brush coats of the filler and surfacer, eight hours apart, toning down each coat with sandpaper.

Next apply one or two coats of good automobile enamel, and the job is done. If, however, an exceptionally high finish is desired apply a coat of automobile finishing varnish.

These various treatments, will give your car a factory newness.

Care in the operation of a car just after overhauling is as essential as in that of a new car. Don't forget that it takes only a few minutes of careless operation to cause great damage to your automobile.

Up the Amazon River with a Piece of Wire

By Anthony Fiala

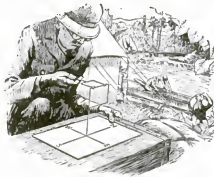
TWO out of three of my canoes had gone under in the Rapids of the Devil, and with them had disappeared all my instruments, maps, and records.

Seven out of nine in the party had been thrown into the whirling, roaring waters, and had just escaped with their lives. I had gone under four times, and had been carried a mile down the cataract before I was saved by grasping the low overhanging branch of a great tree that stretched far out over the waters. Fortunately, one of the boats had escaped, and by its use the struggling men were rescued. The accident had occurred about four miles down river from our starting-place below the falls of the Papagaio, near the Indian village of Utiaity.

Utiaity consisted of a telegraph station, a storehouse, a few adobe huts, and about fifteen wickerlike structures in which the Indians lived. In the storehouse I found, to my delight, a copy of the nautical almanac for 1914, which I had left behind on our first start, an extra copy that I could spare at that time. I took this copy along, as reading matter, everything of that sort having been lost. Rather poor reading matter, and I little thought at the time how valuable it would prove later.

As we journeyed down that interminable waterway, with its never-ending forest-covered banks, its many rapids and cataracts, I was often troubled to know just where we were. I had noticed that the sun was approximately in the zenith. We were traveling north. At that time of the year, February, the sun was also traveling north. My nautical almanac gave me the position of the sun at noon at Greenwich. If I could find the time of apparent noon at our midday stopping-place, and also be

able to determine whether the sun was in my zenith, it would be a simple matter to compute our latitude; for the declination of the sun at Greenwich, corrected for the difference in longitude, would give me the latitude



The wire was bent in the manner shown, and with the help of the sun the lost explorer found his location

without further calculation. I knew our longitude, for I remembered the position calculated for Utiaity, and the river had flowed steadily northward, so that our longitude was practically unchanged.

After thinking the matter over, it occurred to me that I had a small piece of insulated copper wire in my pocket. I had carried it there ever since I had found it hanging to the outside of a small telegraph hut along the line of the telegraph trail while our pack train was crossing the Divide. It was not in use, so I detached it, thinking that a good piece of copper wire should not go to waste, and that it might be of value to me later. It was! The insulation was burned off in our noonday cook fire, and I rolled the wire flat between two stones and bent it into the form of a square, with

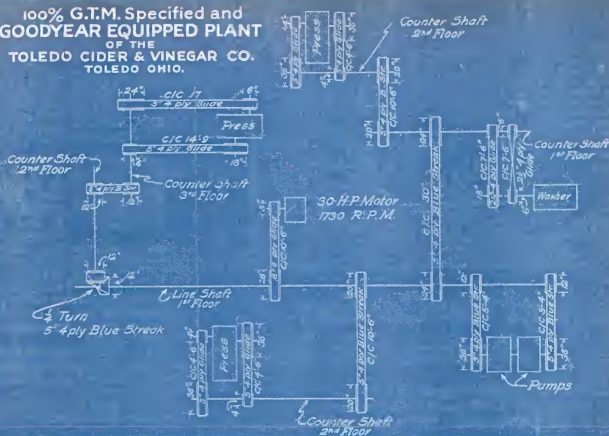
one side prolonged as a plumb-bob, as shown in the illustration. A part of the wire was bent into the form of a handle, so that the contrivance could hang free and be acted upon by gravity.

When the sun seemed near the zenith, I suspended the little square from the handle, with the top wire pointing north and south. If the sun was still a little toward the east, shadows from both the top and bottom wires would be thrown on a paper held below. When the shadow of the top wire covered that of the lower wire, giving only one thin shadow line, I knew it was apparent noon at that place. Noon having been determined, I turned the square east and west, that is, at right angles to its former position, in order to determine whether the sun was north or south of my position. If one thin shadow of both wires was projected on the paper, the sun was in the zenith, and I had only to pick out the declination of the sun for noon at Greenwich for the day from my almanac, and correct it for difference in longitude, to find my latitude.

It was a great pleasure each noon-time, if the sun was shining, to work the little instrument of wire and determine my latitude. I had marked off the paper into degrees and half degrees on each side of a penciled meridian line, using the graduations of a compass owned by Lieutenant Loreado, the needle of which was just half the length of the plumb-bob wire of my instrument. These degrees served as half degrees for the instrument.

When we reached a point where we could meet with men again, I found maps, and was much pleased to see that several of the latitudes secured with the little rough instrument closely approximated the true latitude of our noonday halts.

100% G.T.M. Specified and
GOODYEAR EQUIPPED PLANT
OF THE
TOLEDO CIDER & VINEGAR CO.
TOLEDO OHIO.



Copyright 1920, by The Goodyear Tire & Rubber Co.

100% Goodyear-Equipped—and the G. T. M.

A growing conviction that the Goodyear analysis plan gave promise of ending their continual troubles with belts led the Toledo Cider & Vinegar Company to have a single drive studied by a G. T. M.—Goodyear Technical Man—and his recommendation for a belt given the benefit of a trial.

The G. T. M. did not say offhand, "Put on a Goodyear Belt." His first request was to see the drive for which a belt was wanted. He studied the actual conditions under which the belt must operate. He figured pulley dimensions, center-to-center distances, operating speed required. He noted that a belt to be successful in this plant must resist the action of vinegar acid. In a word, he went to work on the principle that a belt is an integral part of the plant's production line.

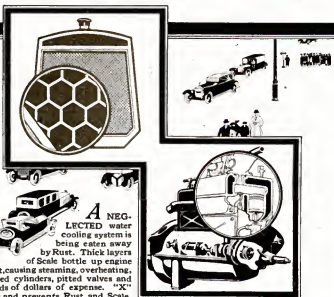
The results from the Goodyear Belt applied after this study made their own argument for an extension of the analysis to the entire plant. The G. T. M.-specified Goodyear Belt held the pulleys, where other belts—bought on the basis of taking whatever the jobber happened to have in stock—slipped, and lost power, and tied up units in troubles and delays that cost money.

100% Goodyear-equipped today—this is the result of expert study followed by the service that Goodyear Belts specified to their work always yield. On the press drives there are Goodyear Glide Belts. On the main-to-counter shaft transmission, and on pumping duty, are 5-inch, 4-ply Goodyear Blue Streak Belts—heavy, flexible and enduring. In line with the same principle of every unit's relation to the work of the whole plant, the G. T. M. specified 5-ply Goodyear Monterey Acid Hose for the conveying of the product pressed out under the action of the power carried by the belts. At the end of a full season's run, the Goodyear equipment shows practically no wear and has furnished new records for energy conserved and power transmitted.

Single drive or entire plant, the G. T. M. looks at any problem put up to him in the light of its relation to profitable production. And the Goodyear belt he recommends is chosen first for its ability to perform its part unflinching, trouble-free, over a long period of economical service. The G. T. M.'s services are at your and your plant superintendent's command, without charge. Your profit and satisfaction from Goodyear Belts specified on the basis of his analysis are ample assurance of our return.

BELTING • PACKING HOSE • VALVES
GOODYEAR

RADIATOR walls are made thin as paper and not over 1/16th of an inch apart. There are 24,000 joints that may leak. "X" Liquid makes a permanent repair everywhere. Quicker, safer and more economical than soldering.



A NEGLECTED water cooling system is being eaten away by Rust. Thick layers of Scale bottle up engine heat, causing steaming, overheating, scored cylinders, pitted valves and hundreds of dollars of expense. "X" eliminates and prevents Rust and Scale.

Overhaul the Cooling System this Spring

Use "X" LIQUID to repair all leaks and prevent new ones; to clean out all Rust and Scale and keep them out. "X" cuts upkeep costs.

MOST car owners give the engine a complete overhauling regularly—and unwisely neglect the cooling system.

Yet the water circulating system directly concerns engine efficiency. It is the breeding spot of much engine trouble.

Along about midsummer, Leaks—Rusts—and Scale may cause your motor to work at about 50% of its efficiency!

Do this today

Flush the cooling system thoroughly to get out the loose Rust and Sediment. Then pour a can of "X" Liquid into the radiator. Leave it there a few days. This will clean the cooling system walls from Rust and Scale now present. Drain the radiator. Save the "X" Liquid by straining through cheese-cloth. Pour back the "X" and no new Rust or Scale will form while the "X" is in the water.

Repairs leaks and prevents them

The same "X" that eliminates Rust and Scale also repairs all breaks in any part of the cooling system—radiator, pump, around motor-head gaskets, even cracks in the waterjackets. Makes a permanent repair that stands 2000 pounds pressure. "X" does more than soldering in quicker time and at far less cost.

Not a radiator cement!

"X" Liquid is a scientific chemical process and must not be confused with radiator cements, flaxseed meals, or "dopes" in powder or liquid form.

These may harm the system. "X" positively improves it! Get "X" Liquid from your dealer. Used by the U. S. Government, Standard Oil Co., Am. Tel. & Tel. Co., and others. Guaranteed to work—or money back.

Large Size, \$1.50

will do a \$25 repair job!

Ford Size, 75c

Write for proof of how one can of X Liquid did a \$150 repair job



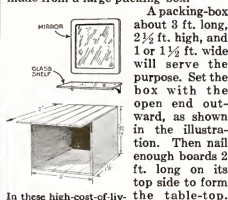
"X" LABORATORIES, 25a West 45th St., NEW YORK CITY
Pacific Coast Branch: 450 Rialto Bldg., San Francisco, California.



X Liquid makes all water cooling systems LEAKPROOF • RUSTPROOF • SCALEPROOF

The Packing-Box Turns Dressing-Table

AN adornment to any bedroom is this very useful dressing-table made from a large packing-box.



In these high-cost-of-living days a dressing-table made from a packing-box is very acceptable

When papered inside with a pretty wall-paper, the box will serve admirably as a receptacle for shoes or small household articles.

The top of the box is padded slightly and covered with cretonne, while cretonne curtains are fastened around the edge by brass tacks.

A mirror and a glass shelf complete the dressing-table.—LUCILE E. CLOSE.

Keeping Small Bolts and Screws Conveniently

THE illustration shows a tray to hold screws, rivets, brads, bolts, and other small articles of assorted sizes.

It is made from a one-inch board and a collection of tin cans of medium size. The cans are cut lengthwise, leaving a tab on each side. These tabs are flattened out, and have holes



Some old tin cans cut lengthwise and a piece of board make this handy screw and bolt tray

punched in them. When square holes of suitable size have been cut in the board, the cans are tacked securely to the under side so as to fit beneath the holes.

Sliding ways may be provided under a work-bench or a cabinet, and the trays made to slide in like a drawer. Each of the small receptacles being rounded on the bottom, small objects can be easily picked up with the fingers.

If the hole in the board is a very little smaller than the can, small objects will not spill out, even when tilted.—H. F. GRINSTEAD.

Meeting the Gasoline Crisis

IN nineteen years motor vehicles have increased in number 60,600%. Motor fuel production has increased only 1,500%

AUTOMOBILES HAVE INCREASED FORTY TIMES
FASTER THAN GASOLINE PRODUCTION

To get more and more gasoline out of petroleum, oil refineries have had to lower their standards. Gasoline is getting heavier and heavier. It is more like kerosene this year than ever before; it will be still more like kerosene next year.

But automobile engines are designed to burn the gasoline of five years ago—not the gasoline of today. They are hard to start; they waste fuel; they are inefficient. You can't burn big lumps of coal in a stove intended to use peacole; you can't burn the gasoline of today in engines designed to burn the gasoline of yesterday.

Professor Fishleigh of Michigan University has shown that out of a dollar's worth of gasoline most engines get only ten cents' worth of useful work.

Now the engineers of Chalmers Company decided several years ago that engines must be improved so as to burn gasoline of today—not to waste it. Two years ago they gave the world the Chalmers Hot

Spot engine with the Ram's-horn intake manifold.

What is the Hot Spot? What is the Ram's-horn?

Present day gasoline doesn't vaporize easily—doesn't produce "gas." Whole drops of gasoline are sucked into the cylinder through the intake manifold. In the Chalmers engine the gasoline, wholly or partially vaporized, strikes the Hot Spot before it enters a cylinder. Instantly the drops are changed into "gas." Not raw fuel, but "gas" is fed to the engine—something which will burn.

The Ram's-horn intake manifold makes it easy for this pre-heated, completely vaporized fuel to enter the cylinders. It is shaped like a ram's horn in order to get rid of sharp corners. Every gas is composed of billions of molecules. Those in vaporized gasoline rush into the engine at the speed of 100 miles an hour. They must not be stopped suddenly by a corner. The Ram's-horn makes it easy for them to enter the cylinders.

CHALMERS MOTOR CAR COMPANY, DETROIT, MICHIGAN

CHALMERS MOTOR CO. OF CANADA, LIMITED, WINDSOR, ONTARIO

MAXWELL MOTOR SALES CORP., EXPORT DIVISION, 1808 BROADWAY, NEW YORK

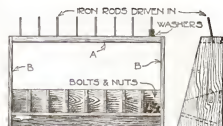
The Hot Spot and the Ram's-horn do this:

1. They make it easy to start.
2. They give you more miles per gallon of gasoline.
3. They reduce carbon deposits in the cylinder.
4. They make it impossible for raw, unburnt fuel to drop down into the crank case and "cut" the lubricating oil.



Selecting the Right Bolt at a Moment's Notice

THE construction of a bolt, nut, and washer rack that may be either secured to a wall or placed upon a bench is shown in the accompanying illustration. The washer rack consists of a piece of wood, A, about 2 by 4 in., into which are driven pieces of



With the rack here illustrated you can select immediately the particular bolt or nut you desire

$\frac{1}{4}$ -in. round stock corresponding in number to the different sizes or varieties of washers used in the shop for which it is built.

The end pieces B B, cut from 1-in. wood, are nailed or screwed to the ends of A, and near the bottom a series of wooden bins are built in for holding a variety of bolts and nuts. The sizes of bolts and washers are marked on the edges of the rack, making it possible to select a wanted size bolt, nut, or corresponding washer in a moment.

Two Useful Suggestions for the Motorcyclist

A MOTORCYCLIST of experience never goes out without having prepared himself for any emergency. He carries as many duplicate parts of his machine as is convenient, and he carries whatever tools may be neces-



A convenient holder for small parts made from a piece of inner tubing vulcanized at one end
sary to put them on. Two helpful ideas are shown in the accompanying illustrations.

One illustration shows a good way to carry such small parts as bolts, nuts, chain-links, and the like. A small length of an old inner tube from a motorcycle is cut off, and one of the ends of this length is vulcanized together. The parts may then be placed in this, and the open end of the holder can be folded down and secured by a rubber band—or, better still, by a

The Upholstered
of Quality

CHASE

Leatherwove

MADE BY SANFORD MILLS
SANFORD, ME.

AFTER years of scientific research and experiment Chase Leatherwove was produced to fill a much needed want—an appropriate and practical material for upholstery purposes.

For Motor Car, Furniture, Carriage and Boat Upholstery

Characteristics not found elsewhere have been given to Chase Leatherwove by special processes. It is the better upholstery material of today—durable—especially tough though pliable—distinctive and rich in appearance; water proof; easily cleansed; economical.

Re-upholster with Chase Leatherwove. An inexpensive amount of Chase Leatherwove will do wonders. The results will please you.

Like several other nationally known products bearing the "Chase" trademark, Chase Leatherwove is strictly a high-quality, reliable and honest production—backed by our reputation gained through seventy-three years of manufacturing leadership.

Samples of this Better Upholstery material on request. Always demand Chase Leatherwove.

Manufacturers of Trunks and Bags, Shoes, Books, Novelties, etc., are asked to see the several different grades of Chase Leatherwove, made especially for their use.

L. C. CHASE & CO., BOSTON,

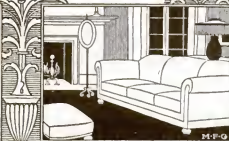
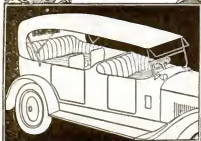
NEW YORK DETROIT SAN FRANCISCO CHICAGO

Leaders in Manufacturing Since 1837

Other products of our mills:

Chase Dreadnaut Motor Topping;
Chase Plush Motor Robes;
Chase Horse Clothing

Chase Velveteen Upholstery Fabrics;
Chase Furwove Fabrics;
Chase Wearform Motor Cloths.



THIS IS A CHASE PRODUCT

Why the Notches?

The notches or side vents in a Kelly Caterpillar tire are not put there for ornament.

They serve a very definite purpose—several, in fact.

They give greater traction. They enable the tire to grip the road surface. A Kelly Caterpillar can roll serenely over a road on which the ordinary tire would be helpless without chains.

They greatly increase the tire's resiliency. In a Caterpillar the rubber displaced under load pressure has somewhere to go—and it can go there quickly.

The traction wave is practically done away with. It is broken every few inches so that it has little opportunity to damage the tire or hold back the truck.

These are merely the advantages which the notches add to a tire that even without them would be in a class by itself.

Kelly-Springfield Tire Co.

GENERAL SALES DEPARTMENT

New York, N. Y.



KELLY SPRINGFIELD TRUCK TIRES



"It's a WDC"

The man who knows pipes is quick to recognize the finer points of a WDC.

He sees careful workmanship in every line. He appreciates the improved smoking qualities that Demuth seasoning gives.

Genuine French Briar.

Your dealer carries and recommends the WDC.

WM. DEMUTH & CO.

NEW YORK

*World's Largest Makers
of Fine Pipes*



I WANTED

Representatives in Every Factory

Popular Science Monthly keeps abreast of the times in new inventions and discoveries. Many of the new things come from the skilled workmen in the factory.

We must representatives in every factory in the country. It will send you a list of the new things made.

POPULAR SCIENCE MONTHLY, 225 West 38th Street, New York



**\$3 AND \$4 WILL BUY
A Beautifully Reconstructed
TYPEWRITER**

With Every Modern Writing Convenience

WRITE TODAY FOR ILLUSTRATED CIRCULAR
Explaining Try-Before-You-Buy Plan
HARRY A. SMITH, 306-218 North Wells St., Chicago, Ill.

How to Make Wireless Instruments

A little book that fully describes the construction of spark wireless instruments and apparatus. Just the thing for the amateur. Illustrated. Price, postpaid, 25c.

Book Dept., Popular Science Monthly
225 West 38th St., New York City

Book on Law Free

Write today for our new 171-page book on "The Power of Law Training." It contains a vital and inspiring message to every ambitious man. Find out about the opportunities that await the law-trained man. Find out how you can learn the science of the law right in your own home. No obligation. The book is absolutely FREE.

Write Today—
American Correspondence School of Law
1694 Manhattan Bldg.
Chicago, Illinois

small catch such as might be taken from an old bicycle tool-bag. A holder such as this will keep all the parts safe and clean. When folded up, it will fit in any corner of the motorcycle tool-box.

No special wrench need be carried for taking off such parts as are ordinarily inaccessible to the monkey-wrench. The ordinary wrench may



A wrench, in conjunction with a flat-nose plier, removes parts that could not be taken off by the wrench alone

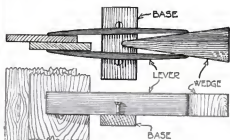
be used in conjunction with a pair of pliers in the manner shown in the illustration. Here the air-valve casing of the carburetor is being removed when usually the wrench alone has not enough

leeway to allow it to turn the casing at all. The head of the casing is simply grasped by the pliers, the monkey-wrench is fitted over the pliers near its joint, and by twisting on each of the two the parts may quickly be removed.

How to Make a Bench-Clamp that Will Hold

WHEN two boards are to be held together for any length of time and a screw clamp is not handy, build one like the following and it will do good service.

Form a base of hard wood in about the proportions shown in the illustration, and set in two long screws somewhat farther apart than the pieces to be clamped together. Then whittle out two levers of hard wood about $\frac{3}{4}$ in. wide in the middle and



A clamp that is very easy to make and very serviceable to have about any work-bench

slightly tapering toward the ends. One side is straight and the other slightly curved. Set these between the screws and place the pieces to be clamped between them. Next drive a hard-wood wedge between the opposite ends until they spread sufficiently to grip the pieces tightly together.

To insure the clamp gripping without the possibility of slipping, roughen the inside surfaces of the levers and the edges of the wedge so they will not become easily polished with use.—L. B. ROBBINS.

Going to bed in style!

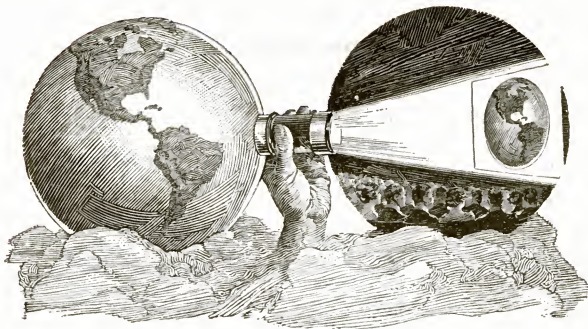
Faultless
Pajamas & Night Shirts
"The Nightwear of a Nation!"



Rest assured.

E. ROSENFELD & CO. MAKERS

BALTIMORE • NEW YORK • CHICAGO



Projecting the world through a lens

THE motion picture and the stereopticon—made possible by lenses! Lenses to record history or story, lenses to project them! Approximately 120,000,000 feet of film shown by them daily to millions of people in America's theatres!

And through lenses we are whisked o'er the seven seas—into dreamlands and real lands—into the midst of raging battle, or into the peaceful love of a childish paradise.

And through lenses are flashed upon the screen the miracles of growing plant life and the secrets of the microscope, made still larger that all may see.

All the strange, new worlds within worlds—the worlds of industry, of medicine, of fiction, of love, of war, of truth—all these are brought to all the people, because there are lenses—those bits of marvel glass, marvelously ground—that do weird things with light.

That this institution has been the leader in lens and other optical development since the middle of the last century, is our incentive to maintain that leadership and do even more, "that eyes may see better and farther."

Write for literature on any optical product in which you are interested

BAUSCH & LOMB OPTICAL COMPANY . . . ROCHESTER, N. Y.

Makers of Eyeglass and Spectacle Lenses, Photographic Lenses, Microscopes, Balopticons, Binoculars and Engineering and other Optical Instruments





FLORSHEIM stands for what you want in shoes—quality materials and workmanship—distinguished style—comfort and long service. The exact points that you would like to be sure of you can be sure of in shoes bearing the quality mark "Florsheim."

Fifteen to Twenty Dollars Consider the wear, not the price per pair.

Look for the quality mark "Florsheim."

The Florsheim Shoe Company CHICAGO, U. S. A.

Write for book, "Styles of the Times."

The Rainbow—M-45



The Wideawake Dealer has it

He's the ounce-o'-prevention, pound-o'-cure man ready to prescribe a few feet of Garco to relieve you of all future brake lining trouble.

Garco Asbestos Brake Lining will not burn. Oil and dust will not harm it. The hardest kind of service is the sort of chance Garco is seeking to prove its every-way-you-look-at-it dependability.

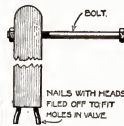
Ask your dealer about Garco.

General Asbestos & Rubber Co. Charleston, S. C. NEW YORK CHICAGO PITTSBURGH

GARCO
ASBESTOS
BRAKE LINING

How to Grind Valves in an Emergency

WHEN a valve needs grinding and no proper tool is at hand for the job, one can be what will serve the purpose.



If your engine valves need grinding, don't wait to buy a tool—make it

Cut off a suitable length of round stick, such as a broom-handle, and drive two stout wire nails in the flat end. Bend these to fit the holes in the valve head, or file their ends to an edge so as to fit in

the slot, if the valve head is of such a nature. Then drill a hole near the top of the shank and fit in a bolt or nail, as shown, for a handle. The result is a satisfactory valve-grinder that cost nothing but a little time.

Set the nails in the valve, place the palm of the left hand over the top of the shank to hold it down on the valve, and rotate the grinder back and forth by the handle held in the right hand.—THORNTON HALLETT.

Using a Nail-Set to Ream into Metal

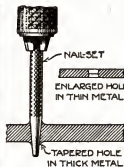
BY merely substituting a nail-set for a drill-bit, holes may be enlarged and taper holes reamed or produced in sheet metal.

If the metal is relatively thick, the holes thus produced will have a distinct taper. This can be offset by reaming first from one side and then from the other. If this is done in thin sheet metal, the taper is greatly reduced.

One important point about this method of reaming is that it leaves a perfectly clean, smooth hole. The small burrs raised on either side of the metal can be easily taken off with a whet-stone. It is also possible to stop at just the desired width of hole.

The nail-set can be used in any chuck holding a round-shank bit, in a brace, chain-drill, or bench-drill. The ordinary feed should be used and a little oil applied to the point.

This method is often particularly valuable in threading holes for tapping, when the proper drill is not to be had and all that is necessary is to widen a hole that is too small to permit the point of the taper tap to enter.



Small holes can be easily and quickly enlarged with a nail-set

Quick-Action Advertisements continued from page 16

STAMPS AND COINS

NEVER sell Old Coins until you see our Copyrighted Old Illustrations, Coin Value Book (New Edition) showing high prices we pay. \$100.00 paid for 1914 dime. 5 Mini. Send 10c for your copy to-day. You may have valuable coins. International Coin Co., Box 104, Philadelphia, Pennsylvania.

CALIFORNIA gold quarter size, 27c; 8c, size 35c white cent and catalogue 10c. Norman Shultz, King City, Missouri.

100 Different Stamps, 10c; 200, 25c. Approvals, Michaels, 5300 Prairie, Chicago.

STAMPS—different—interesting Lists free. Postage 2c. Palm Stamp Company, 138 North Wellington Street, Los Angeles, California.

20 Excellent stamps—No. 100—Homeless! Stamp News, year 25c—Merit approvals—60c discount. 5 French Colonies Free. Postage 2c. Edwin H. Bailey, Minneapolis, Minn.

10c Genuine Foreign Stamps—Mexico War Issues Venezuela, Salvador, Cuba, Servia, Guatemala, China, etc., only 10c. Finest Approval Sheets 40c to 50c. Agents, Canada, U.S. 72-95, Little Free. We buy stamps. Established 25 years. Hussian Stamp Company, Dept. 55, St. Louis, Missouri.

STAMPS, 61 All Different, 3 cents. Mention paper, Quaker Stamp Co., Toledo, Ohio.

1c to 500 paid for hundreds of old coins dated before 1815. Send 10 cents at once for new illustrated coin value book. Still paid 10c. May mean your fortune. Clarke & Co., Coin Dealers, Box 76, Lefroy, N. Y.

PACKET "A" 100 varieties foreign stamps, 20c. F. J. Pope, Charlotte, Vermont.

100 Varieties Haiti Stamps 20c. List of 7000 varieties low priced stamps. Postage 2c. Humberg Stamp Co., 111C, Nassau Street, New York City.

STAMPS—50 varieties, Transvaal, Brazil, Peru, Cuba, Mexico, etc., only \$5.00, 100 value 5c. Send \$1.00, 1,000 stamps, 10c, 1,000 mixed 40c, 1st free. 1 day stamps. C. Steyer, New York, Code Books, New York.

CALIFORNIA gold quarter size and Columbia Nickel, 3c. 10c coin and catalog, 10c. Homer Schultz, Union Star, Missouri.

STAMPS—different British, Guinea, China, Jamaica, Portugal, Venezuela, etc. 10c; 1,000 all different, one collection only \$5.00, 100 value 5c. Send \$1.00, 1,000 stamps, 10c, 1,000 mixed 40c, 1st free. 1 day stamps. L. H. H. Steyer, New York, Code Books, New York.

BEST one-cent approvals in America. F. F. Hand, 1111 North 60th Street, Philadelphia, Pennsylvania.

STAMPS—different from every mail-order house; 10c to 1,000 foreign coins, 25c; 100 Uruguay stamps for 10c. Lots free. Toledo, Ohio.

OLD coins, large saving selling catalogue of coins for sale, free. Catalogue quoting prices paid for coins, ten cents. William Hensley, 108 Tremont Street, Boston, Massachusetts.

STAMP collecting, coins, bills, antique firearms, swords. Catalog free. Antique Shop, 35-A South 10th, Philadelphia, Pennsylvania.

FREE to our readers: How can I improve myself? How can I make myself more prudent, and thus earn more money? You don't have to go to college. You don't never want to college. But he has, we believe, the finest library of technical books in the world. If you want helpful, practical books on electricity, mechanics, mechanical engineering, wireless, automobile engineering, sheet metal work, woodworking, repairing, or any other subject, write for Popular Science Monthly's new book catalog. The book described in it have been carefully selected by experts as best adapted to the needs of Popular Science Monthly readers. Our catalog is free to our readers. A postal request will bring it. Look Department, Popular Science Monthly, 225 West 39th Street, New York City.

60 Different Asia stamps 25c; C. Reutter, Box 1064, Detroit, Michigan.

SPECIAL 1000 Different stamps, \$2.60. C. E. Nickles, 122 Florida Avenue, Washington, D. C.

TRIANGLE Approvals—1c up. Three unused stamps free to approval applicants sending references. Hartford Stamp Company, Dept. 3, Germantown, Pennsylvania.

THOUSANDS paid for Old Coins. Save all before 1800 and send for 1920 premium book, ten cents, with large copper cent three cents. It may mean your fortune. E. C. Hart, Nora Spang, Iowa.

BOOKS AND PERIODICALS

BOOKS Thousands! All Best! Postively Brand New! Books for sale, 25c up. Interest and up-to-date; finest publishers. Mechanics, Electrical, Automobiles, Automobiles, Machinery, Tractors, Scientific, Technical, Business, Salesmanship, Advertising, Geography, Dictionaries, Encyclopedias, Fiction, Agriculture, Education, Law, Medicine, Mathematics, Languages, Electrical, Mechanical, Civil Engineering, Big catalogues, complete lists. Free. Send—Now! C. Goodrich & Son, Dept. "A," South Street, Massachusetts.

FREE—"The Western Miner" three months to get acquainted. Devoted to an exceptional investment and general news. The Western Miner, 2541 West 37th Avenue, Denver, Colorado.

BOOK—Describing 100 atrocities and their attacks on women and girls in Belgium. 25c. Belgium Specialty House, 283 Union Avenue, Dept. 3, Chicago.

BOOKS, Literature, etc. Lasts. Hignett's, R2411 Post Street, San Francisco, California.

MECHANICAL, Scientific, Technical Books, covering every trade. Complete catalogue free. Howard Company, Dept. 35, 20 West 40th Street, New York.

THE Truth Seeker in its 47th year! is an Agnostic weekly, discussing the most important subjects of the day, sample, mailed, One Dime. Catalogue of books free. 62 West 37th Street, New York.

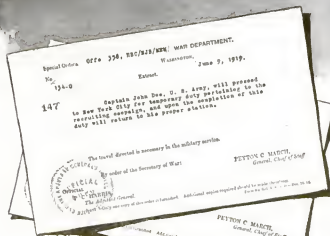
BLUEPRINTS: How to read. See page 12. Mechanics Improvement Association.

10000 USED books for sale, 5c up. Some cost \$10.00 new. History, Scientific, Technical, Science, etc. Catalogue 10c. McCarthy, 1061 West Van Buren Street, Chicago, Illinois.

CONCORDIA contains essays, formulas, plans. Year's subscription 10c. The Publishers, Concordia Magazine, 11 Water, York, Pennsylvania.

INSTRUCTION Book (for shop use) on Ventilation, Auto-Fire, A. T. The Publishers, Concordia Magazine, Cincinnati, Ohio.

AMPLE Wireless Telephones and How to Make Them. A good book for the advanced radio amateur on the principles of wireless and the construction of wireless telephones. Price 35 cents postpaid. Book Dept. Popular Science Monthly, 225 West 39th Street, New York.



Teaching the Army to Coronatype

THIS official photograph shows part of a class of sixty non-commissioned officers at Camp Alfred Vail, N. J., being trained to coronatype their army paperwork with military precision and accuracy.

The confidence placed in Corona by the United States Army, born of recent experience with this little machine under conditions of a severity never before met by any typewriter, is well attested by the fact that coronatyping has become part of the standard instruction for company clerks.

Aside from its convenience and portability, Corona's record for absolute dependability is largely responsible for its rapidly increasing use. Corona appears more and more frequently in the modern office, in the quiet and comfort of home, and, folded into its convenient carrying case, as the companion and confidential secretary of the traveler. For business or personal correspondence, for reports, manuscripts, memoranda, you will find Corona invaluable, whatever and whenever you write.

CORONA TYPEWRITER COMPANY, INC.
GROTON, NEW YORK

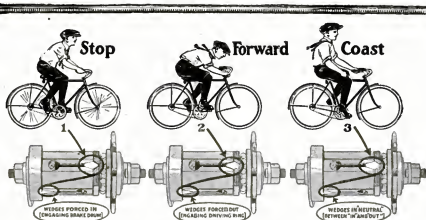
Consult your telephone book for address
of local Corona agency.

CORONA

The Personal Writing Machine

-fold it up-take it with you-typewrite anywhere





A Morrow Brake Does All Three Right

You wish to *stop* your bicycle. That is easy if it is equipped with a

Morrow STURDY, SURE COASTER BRAKE

Simply back pedal. Four small wedges, two acting from each end, will expand the brake drum. Thus the bronze "brake shoes" on the drum are brought into contact with practically the entire inner surface of the steel hub, and your bicycle is stopped—instantly or gradually, as you choose.

You wish to *go forward*? Just pedal forward and the wedges will be forced outward, leaving the "drum" neutral and expanding two "driving rings" which in turn, "take hold" of the inner surface of the hub and drive your "bike" forward.

You wish to *coast*? Just let your feet remain idle. The rear sprocket will be motionless, leaving the "drum" and "driving rings" neutral, and you will enjoy smooth, almost frictionless coasting.

7 Reasons for the Morrow

- 1 Braking surface 6 1/2 to 10 in.—much larger than other brakes.
- 2 "Drum" expansion forced equally by two wedges at each end, insuring even braking distribution over entire inner hub surface.
- 3 Bronze brake shoes being softer than hard steel inner surface, grip smoothly, firmly, surely.
- 4 For forward pedaling, the Morrow responds instantly and positively.
- 5 Hare-hill-bearing hammerbrakes, so engage more easily.
- 6 The Morrow is strong and sturdy; it will stand hard wear.
- 7 Ninety-day inspection, followed by a final test guaranteeing perfect service.

ECLIPSE MACHINE COMPANY

ELMIRA, NEW YORK

Demand the MORROW on the next Bicycle you Buy

DO YOU WORK IN A FACTORY?

\$10 to \$25 a Week for an Hour a Day

We want a representative in every factory in the United States. You can easily earn \$10 to \$25 extra each week by using an hour a day of your spare time. Write today giving the name of the factory where you are employed.

Popular Science Monthly

225 West 39th Street, New York

THE REAL ESTATE EDUCATOR, by W. M. Payne, A. regulatory of useful information for ready reference, especially designed for real estate agents, operators, builders, contractors and business men. This book gives the most comprehensive yet most concise arrangement of useful facts about buying, selling, leasing and sub-letting of Real Estate—very carefully gathered together on this vital subject. Cloth, 500 pages. Price, \$1.50, Foreign.

Book Dept., POPULAR SCIENCE MONTHLY
225 West 39th Street New York

Skinderviken Transmitter Button



Is universal for making up Deaf-phones, Detectors, Amplifiers, etc. Put a button on the outside of a window and listen to all that is said inside. Attach it to your Phonograph and transmit music, etc., to distant points. The best Transmitter for Local and Long Distance Telephone. Saves 75% Batteries. Super-sensitive.

Send me \$1.00 for one Button with free

descriptive booklet E-5 and circuit diagrams. All kind of experimenters' supplies in stock. Receivers, induction coils, condensers, etc. Price list on request. Satisfaction guaranteed or money back.

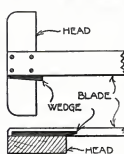
J. SKINDERVIKEN

Inventor and Sole Manufacturer

335 Broadway, N. Y. C., or 154 W. Randolph St., Chicago, Ill.

An Adjustable Table for the Draftsman's T-Square

DRAFTSMEN can make a T-square with an adjustable blade. The head, which should be carefully made from some hard wood, such as birch or black walnut, has a routed



Here is a useful piece of apparatus for the draftsman, which can be made at home

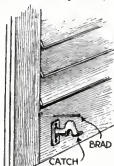
depression a little wider than the width of the blade. One edge of this mortise is at right angles to the working edge, while the other is slightly inclined at an angle, in order to accommodate a narrow wedge between it and the blade. The blade is fastened to the head by screws, but is further forced against the square edge of the mortise by the wedge. By beveling the broad end of the latter at its under side and rounding the outside corner, the wedge is kept off the drawing-table.

In making the square, the mortise should be routed out before the curve of the head is shaped. Care must be taken to keep both edges of the mortise exactly straight. The head is then shaped, the blade set in without putting in the screws, and the square tried out on the drawing-table. The head is trued up with a jointer.

This type of square has the advantage that the blade, while easily removable, is held to true with an unusual degree of accuracy and rigidity. A blade that has become injured or warped can be taken out, and when replaced will automatically come to true. The blades seldom work loose on the head, but should this happen a couple of taps against the end of the wedge sets it up absolutely tight.—HENRY SIMON.

How to Prevent Sparrows Roosting on Blinds

A SIMPLE means of preventing that city pest, the sparrow, from sitting upon blinds and twittering outside of your window all day long is to drive a wire nail about 1/16 in. in diameter into the blind 1 in. directly over the catch where the sparrow roosts. This makes the sitting place too small for the bird without in any way interfering with the opening and closing of the blind.—C. H. SMART.



Drive a nail over the catch in your blind and make Mr. Sparrow roost elsewhere

the bird without in any way interfering with the opening and closing of the blind.—C. H. SMART.

Genco

RAZORS

Reg. U. S. Pat. Off.



“How’s the razor this morning?”
asks your barber

He wouldn’t ask you, if his razor pulled or scraped. It doesn’t, because he’s using a regular razor—of the GENCO type—and he stropped it before he began to shave, just as you could strop one to shave yourself. It travels over your face so smoothly because it has been stropped. Any barber will tell you that a perfect shaving edge can be had only on a regular razor and by stropping. That’s why barbers all use regular razors.

Anybody Can Strop a Genco Razor

It’s easy, because every GENCO Razor is especially designed to strop. Its back is broad; its blade is hollow ground—ground with a slight but vitally necessary bevel right behind the edge. These three

features compel every GENCO to meet the strop at the right angle. A few light strokes and there you have a regular professional shaving edge.

Go to your dealer and ask to see a GENCO. Look for the features mentioned. Notice the beautiful steel in it—hand-ground, perfectly tempered, good for a lifetime. You’ll be surprised at the reasonable price charged for such a good razor. That same keen, business-like blade every morning will save you a lot of time and money.

You’ll buy one, because it looks right, feels right, and perhaps because of our sweeping guarantee—“GENCO Razors must make good or we will.” And, after shaving with it, you’ll boast of it as a find.

If your dealer hasn’t GENCO Razors, write to us for one

Geneva Cutlery Corporation

47 Gates Avenue, Geneva, N. Y.

Largest Manufacturers of High-grade Razors in the World



Genco

RAZORS

Reg. U. S. Pat. Off.



Note how GENCO Razors meet the strop in just the proper way to assure a perfect shaving edge. The bevel lends backbone to the edge and guides it on the strop.



For the out-of-doors days

KODAK

And not merely the alluring picture story, but on every negative at least a date; and a title, too, if you like. Titling is the work of but an instant with an Autographic Kodak; is as simple as making the picture itself—and there is no extra charge for Autographic film.

If it isn't an Eastman, it isn't a Kodak.

EASTMAN KODAK CO., Rochester, N. Y., *The Kodak City*

Catalogue free at your Dealer's or by mail.

You'll Never Know When You Need a Daylo

This letter, recently received from a young man in Montreal, proves the above statement:

"I bought a Daylo on November 3rd. On the 4th there was a fire in our block. Hearing that the owner's children were inside, I went up a ladder at the back of the house. I went in through a window. The fireman had no light. With my Daylo, I could just see my way through the dense smoke and underneath it a child, unconscious. I picked the child up and headed it out the window to a fireman." (Signed) Robert Maw, Jr.

How Many Uses For Daylo In The Home?

HERE'S one use for Daylo that's worth ten thousand times the cost of the light. The one chance in a million that Robert Maw, Junior's, experience may happen to you is too big a chance to overlook in protecting your dear ones.

Night or day—there are hundreds of places in the home and hundreds of times when you need a Daylo to penetrate darkness with its brilliant beam of long-lived light.

Buy a Daylo now, before you forget it. And have a regular place to keep it—on the kitchen shelf, under your pillow, near the front door, at the head of the cellar stairs—wherever you need it most.

All leading electrical, hardware, drug, sporting goods, and auto accessory stores have a supply of Daylo. And they carry the genuine Eveready Tungsten Batteries for all "flashlights."

Coming: \$10,000 Cash Prize Contest. Ask your dealer.

AMERICAN EVER READY WORKS
of National Carbon Company, Inc.
LONG ISLAND CITY, NEW YORK

NATIONAL CARBON CO., Inc.,
San Francisco, Cal.

CANADIAN NATIONAL CARBON COMPANY, Limited
Toronto, Ont.



Makers of the famous **EVEREADY STORAGE BATTERY**
Guaranteed 1 1/2 Years

"Good Electrical Repair Men Are Scarce"

As Motor Age says, 75% of all auto repairs are electrical, and there are not enough trained men to do the work. The addition of electric starting and lighting to all cars has vastly increased this demand. The small town repair or battery shop must know how to make electrical repairs or lose trade to the city.

Learn Automotive Electricity

And make good wages or have a shop of your own. We teach all the theory and practice of starting, lighting, ignition and batteries—as well as farm lighting—in an 8 week course of individual instruction. Instructors are specialists in their line and their work is practical and thorough. Classes, limited to 20 students each, start every two weeks.

Write now for course book and details of course. **CHINA** will send to you.

AMBU ENGINEERING INSTITUTE
401-1811 S. Michigan Ave., CHICAGO
Founded by Amer. Bureau of Eng. Makers of **AMBU** Troubleshooting

Editorial in "Motor Age" says: "Increasing demand for electric service. The time is here when the subject of electrical service is one of the most important to the dealer who will cash in. Good electrical service is a dealer's good reputation for quick and efficient electrical service. In order that electrical service should be better than 75% of automotive service."

Double Service From One Socket

Why do without light when using your electric light socket for the wambler?

Benjamin Electric N.Y.C. Co. Gives extra outlets to single sockets. At Your Dealer's. 34¢ 350¢ PER WIRE EACH. BENJAMIN ELECTRIC N.Y.C. CO. Chicago New York San Francisco

Dollars in Hares

We pay \$7.00 to \$12.50 a pair and express charges. Big Profits. We furnish guaranteed high grade stock and buy all your raises. Use hockyard, barn, cellar, attic. Contract and Illustrated Catalog Free. STANDARD FOOD AND FUR ASSN. 107C Broadway New York



with strips of felt to make it practically airtight. It was fastened by means of a catch, as shown in Fig. 1. Over the mouth, where the rim had formerly been, a large heavy funnel was soldered.

Fig. 2 shows the construction of the fan. This should be about 16 in. in diameter, or at least 2 in. less in diameter than the diameter of the can,

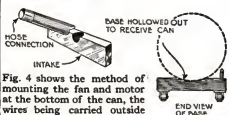
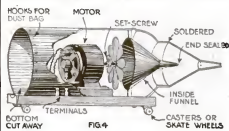


Fig. 4 shows the method of mounting the fan and motor at the bottom of the can, the wires being carried outside

and should have eight blades. Before finishing, the hole for the shaft of the motor is made. Secure a bushing of the right size to fit the shaft and solder it in place. Then provide the bushing with a set-screw.

See that the blades of the fan are true and all alike, and also that the fan balances perfectly when placed upon the shaft. Smooth down the edges and give each blade a sharp pitch—about one third greater than that of the average electric fan.

It might be well now to test out the motor before going any further, in order to decide what pitch works the best. Make sure that all experiments are satisfactory before you close up the cleaner; otherwise trouble will develop later on.

The smaller funnel is placed inside the housing to deflect the dust and trash from the motor. Since the current of air is constant, once past the motor, it will do no harm. This smaller funnel has the end plugged with solder, and is held in the center of the can by light-weight strap-iron supports, bent so that they meet the blast edgewise, as shown in Fig. 3 (shown on page 100). It will be well to use a motor of the enclosed type.

The method of mounting the motor and fan in the bottom of the can is shown in Fig. 4. They are mounted behind, and on a center line with, the inside funnel. Raise the motor on suitable wooden blocks and secure with strap-iron over each end, soldered to the inside of the can. This will hold the blocks and prevent any chance of their working out by reason of the vibration.

Solder a few hooks to the outside of the can to hold a sack for catching the dirt. If it is desired to make the plant portable, fasten on the wheels of an old roller-skate.



Ride a Bicycle to Work

SAVE money! Avoid the miserable jam of crowded street cars! Get to work on time—every time and feeling fine. Ride a bicycle.

The bicycle is the most economical form of transportation. It pays for itself in carfare saved. It is convenient—always ready to go—costs practically nothing to operate—is easy to handle and a pleasure to ride.

Thousands of people have realized the worth of riding a bicycle to work and business. Practically every man and woman in this country will benefit by this money-saving, health-gaining habit. See your dealer today.

CYCLE TRADES
35 Warren Street



OF AMERICA, INC.
New York, U. S. A.

Ride a Bicycle



HIGH SCHOOL COURSE IN TWO YEARS

YOU ARE BADLY HANDICAPPED if you lack High School training. You cannot attain business or social prominence. You are barred from a successful business career, from the leading professions, from well-paid civil service jobs, from teaching and college entrance. In fact, employers of practically all worthwhile positions demand High School training. You can't hope to succeed in the face of this handicap. But you can remove it. Let the American School help you.

FIT YOURSELF FOR A BIG FUTURE This Course, which has been prepared by some of America's leading professors, will broaden your mind, and make you keen, alert and capable. It is complete, simplified and up-to-date. It covers all subjects given in a resident school and meets all requirements of a High School training. From the first lesson to the last you are carefully examined and coached.

USE SPARE TIME ONLY

Most people *idle* away *fifty* hours a week. Probably you do. Use only one-fifth of your wasted hours for study and you can remove your present handicap within *two* years. You will enjoy the lessons and the knowledge you will gain will well repay the time spent in study.

YOU RUN NO RISK So that you may see for yourself how thorough and complete our training is, we invite you to take ten lessons in the High School Course—or any course of specialized training in the coupon below—before deciding whether you wish to continue. If you are not then satisfied, we will refund your money in full. *We absolutely guarantee satisfaction.* On that basis you owe it to yourself to make the test.

Check and mail the coupon **NOW** for full particulars and Free Bulletin.

AMERICAN SCHOOL
OF CORRESPONDENCE
Dept. H-754 Chicago, Illinois

TRAINING—THE KEY TO SUCCESS

Explain how I can qualify for the position checked.

- | | |
|------------------------------|-----------------------------|
| • High-School Graduate | • Lawyer |
| • Electrical Engineer | • Business Manager |
| • Elec. Light & Power Suppt. | • Certified Pub. Accountant |
| • Hydroelectric Engineer | • Accountant and Auditor |
| • Telephone Engineer | • Bookkeeper |
| • Telegraph Engineer | • Stenographer |
| • Wireless Operator | • Fire Insurance Expert |
| • Architect | • Sanitary Engineer |
| • Building Contractor | • Master Lumber |
| • Civil Engineer | • Heating & Vent. Engineer |
| • Structural Engineer | • Automobile Engineer |
| • Mechanical Engineer | • Automobile Repairman |
| • Shop Superintendent | • Airplane Mechanic |
| • Steam Engineer | • General Education Course |
| • Draftsman and Designer | • Common School Branches |
| • Photocopy Writer | • Foreman's Training Course |
| • Employment Manager | |

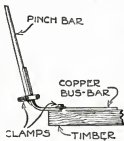
Name
Address

An Ingenious Method of Bending Bus-bars

A COMPARATIVELY easy and simple method of bending bus-bars is here given. Copper bars of considerable length are quite difficult to handle and to bend, with any degree of accuracy, without special apparatus.



The diagram shows a mechanical device for bending a copper bus-bar. A long, thin rod is labeled "PINCH BAR". This rod is inserted into a handle that is part of a larger assembly. The handle is connected to a lever system that can apply pressure to bend the "COPPER BUS-BAR" which is held in a clamp. The clamp is mounted on a base. The entire device is designed to bend the bus-bar without the need for traditional bending tools or equipment.



Procure a piece of heavy timber, and at one end arrange a clamp consisting of a flat piece of iron and a couple of bolts passing through the iron and the timber. Clamp the bus-bar securely under this at the point where the bend is desired, and clamp a pinch-bar to it as shown in the accompanying sketch. In this manner the bus-bar can be bent to any angle desired.

To put a quarter twist in a bar, clamp the pinch-bar to it at right angles to the length of the bus-bar, and give the latter a twist. To bend a bar on edge, heat it at the point where it is to be bent, and then bend it. If the bar is bent on edge when cold, it is difficult to make it stay flat at the bend.

How to Distinguish Automobile Engine Knocks

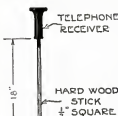
LOCATING knocks in the automobile engine is difficult work even for an expert mechanic. In twenty minutes you can make a detector comparable to a costly stethoscope.



TELEPHONE RECEIVER

HARD WOOD

10



For a few cents you can make an engine knock detector that is really efficient one end of it attach an old telephone receiver. This may be purchased very cheaply from your local telephone company.

By placing the stick end of the detector on various parts of the engine while it is running, with your ear at the receiver end, even the most intricate knocks manifest themselves in a way that is easily distinguishable.

When using the detector on the transmission, jack up both rear wheels from the ground, throw the shift lever into high speed, and pull up the emergency brake so that they will drag in the manner produced in driving. Then you can hear any foreign knocks distinctly.—R. L. PRINDLE.

Statement of the Ownership, Management, Circulation, etc., required by the Act of Congress of August 24, 1912, of Popular Science Monthly, published monthly at New York, N. Y., October 1, 1919, state of New York, before me, the undersigned, a Notary Public in and for the State and county aforesaid, personally appeared O. B. Capen, who, having been duly sworn according to law, deposes and says that he is the Business Manager of the above-named publication, and that the following is, to the best of his knowledge and belief, a true and correct statement of the ownership, management, etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 433 of the Civil Rights Regulations, printed on the reverse of this form, to wit:

[illegible]

(Signed) O. B. CAPEN, *Business Manager*,
Sworn to and subscribed before me this 17th day of
September, 1919.
Arthur A. Blauvelt, Queen's County—2767, New York
County—639, New York Reg. 1612.
(Seal) My commission expires March, 30, 1921.



DO YOU LIKE TO DRAW

Cartoonists Are Well Paid

We will not give you any grand prize if you answer this ad. Nor will we claim to make you rich in a week. But if you are anxious to develop your talent with a successful cartoonist, so you can make money, send a copy of this picture with six 1¢ stamps for portfolio of cartoons and sample lesson.

THE W. L. EVANS School of Cartooning
825 Leader Bldg., Cleveland, O.

An Indoor Toilet
For Every Home Convenient Sanitary

Provides practical, sensible and sanitary accommodations indoors protected from cold, stormy weather.

Makes Homes Modern
Easily installed—Easily cleaned—Plumbing unnecessary. Made of high grade materials, handles soap, food, etc., without staining.

Absolutely Odorless

30 DAYS FREE TRIAL.

Comfort Chemical Closures Co., 1326 Factory Bldg., Toledo, O.

DIAMONDS

For a Few Cents a Day

Diamond bargains—100 cents or more. The greatest Diamond opportunity ever published sent free! A few cents and address. Your choice of diamonds—any size, color, cut, shape, weight, carat, money down. Terms as low as your name is day. 10 percent cash is increased by 10 percent each week. No limit on quantity.

Write Today for 128-page book, thousands of bargains. No obligation. Free information. Write to:

J.M.LYON & CO., 11 Maiden Lane, New York, N.Y.

Learn to Dance!

You can learn For...Trot...One-Step...Two-Step...Waltz and latest "up-to-the-minute" society dances...in your own home...by the wonderful "Peak System of Mass Instruction."

New Diagram Method. Easily learned; no music needed; dancing made simple.

Write for Special Terms. Send today for FREE information and complete low cost offer.

WILLIAM CHANDLER PEAK, JR., 609
Room 101, 321 Canal Street, New York City



YOU'LL find out what roomy oversize, quality materials, and extra-wear features really mean just as soon as you get into Blue Buckle Overalls and Coats. The cut of every piece of wear-quality denim, the placing of every stitch and riveted button is planned so that you get the utmost in service and comfort out of every Blue Buckle garment.

Hundreds of skilled Union workers, the largest overall factory in the world, rigid inspection of raw materials and finished garments are some of the reasons for unexcelled Blue Buckle quality—the *greatest overall value ever put on the market.*

Jobbers OverAll Company, Inc.
Lynchburg, Va.

Largest manufacturers of overalls in the world



**“Strong
for
Work”**

Blue Buckle

Union Made

Overalls



TRADE MARK
YALE

The difference between a hole in the wall and a real door—

A door that doesn't always close and stay closed is no better than a hole in the wall.

A door that has a Yale Door Closer is a real door. It closes every time—quietly, softly, automatically.

If you are tired of doors that slam and bang and shatter—if you are weary of doors that stand open—

You will install Yale Door Closers—and insure comfort and better health; save coal keep out cold and draughts—and preserve the door.

Give your door a Yale Door Closer and it will close as "Soft as Cotton"

See the trademark "Yale" on Door Closers, Yale Cylinder Night Latches, Padlocks, Builders' Locks and Hardware, Bank Locks, Chain Blocks and Electric Holes.

The Yale & Towne Mfg. Co.
Makers of the Yale Locks
Stamford, Conn.

Chicago Office: 22 East Lake Street
Canadian Yale & Towne Ltd.
St. Catharines, Ontario



A Bill-fold Worth Owning

The "American Gentleman" bill-fold will keep your pockets tidy. And it is so neat, so compact, so good-looking that you will be proud to have one always with you. Study the picture. Note the combination of twelve useful features. Features you need daily. The "American Gentleman" is made of genuine leather. Stitched throughout—no edges pasted. Tan or black. Only \$1.00 at any dealer's. Or send \$1.00, with your dealer's name, direct to us and we will mail you one postpaid.

CHARLES K. COOK CO., Inc.
Camden, N. J.

Dealers—write for profitable dealer proposition.

Makers of Collar Bags,
Brief Cases, Tobacco
Pouches, etc.



Things I Made that Reduced the High Cost of Living

The Popular Science Monthly will pay fifty dollars for the best answer

WHAT new use of a mechanical appliance or machine did you make for the purpose of reducing the high cost of living? We know of one fellow that transformed his coal furnace into an oil burner. Another made an iceless refrigerator. There are, of course, many other things and we want to know in how many practical ways we can reduce living expenses. Tell us! THE POPULAR SCIENCE MONTHLY offers three prizes,—a first prize of \$50, a second prize of \$25, and a third prize of \$15,—to be awarded in accordance with the rules set forth below:

Rules Governing the Contest

- (1) Contestants are not limited to the number of methods of reducing the high cost of living, but only one method can possibly win the first prize, only one the second, and only one the third. The contest is open to everybody.
- (2) The method must be clearly shown either in a photograph or in a drawing. If a drawing is sent in, it need not be made by a skilled draftsman. It is sufficient that it should be intelligible. While pencil sketches will be considered, contestants are requested to make their drawings in ink on heavy white paper. The views should be sufficient in number to set forth the use of the appliance very clearly. The contestant's name and address should appear on each sheet of drawings.
- (3) The drawings or photographs must be accompanied by a description, preferably typewritten, in which the method is clearly given. It must be written on one side of the paper only, and it should not be more than 500 words in length. The name and address of the contestant should appear in the upper left-hand corner of the first sheet of the written description.
- (4) The drawings and description entered by contestants must be received by the POPULAR SCIENCE MONTHLY not later than 5 p. m. on Friday, April 30, 1920.
- (5) The judges of the contest will be the editors of the POPULAR SCIENCE MONTHLY.
- (6) The first prize of \$50 will be awarded to the contestant who, in the opinion of the judges, has suggested the simplest and best method of reducing the high cost of living.
- (7) The second prize of \$25 will be paid to the contestant who submits a method next in merit.
- (8) The third prize of \$15 will be paid to the contestant who submits the method third in merit.
- (9) The winners of the contest will be announced in the earliest possible issue of the POPULAR SCIENCE MONTHLY. A description of the methods which win the three prizes offered will duly appear in the pages of the POPULAR SCIENCE MONTHLY, together with the names of the winners.
- (10) The editors of the POPULAR SCIENCE MONTHLY shall have the right to publish meritorious manuscripts which do not win a prize. The regular space rates will be paid to the contestants who submit the manuscripts thus selected.
- (11) When a contestant submits more than one method, the description and drawing by which each is set forth must be sent as a separate unit.
- (12) Manuscripts or drawings will be returned to contestants if stamps are enclosed.
- (13) Send drawings and specifications to the High Cost of Living Editor, POPULAR SCIENCE MONTHLY, 225 West 39th Street, New York City.

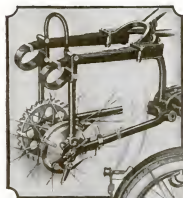
The INDIAN leads in exclusive comfort features

Perfect riding comfort, regardless of the roads traveled, is a bred-in-the-bone characteristic of the Indian Powerplus with the Cradle Spring Frame. Ride at a walking pace or "go it" at a sixty mile clip and the result is the same: You get all the enjoyment the route offers.

The Cradle Spring Frame is perfect from the mechanical standpoint. It is unique in the motorcycle field as a protector for both rider and machine. And it is thoroughly and exclusively Indian.

No matter how abrupt or how numerous the road jolts may be, the Cradle Spring Frame converts every shock into a buoyant gliding impulse that exhilarates.

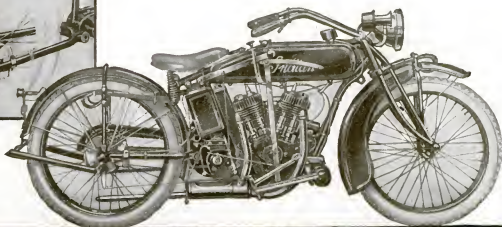
Technical knowledge is not needed to appreciate the Cradle Spring Frame. Observe that the forward end of the horizontal fork is pivoted to the main frame, permitting the fork and wheel to move up and down in the arc. Thus, every jolt is absorbed directly by the resilient steel springs.



HENDEE MANUFACTURING COMPANY

Dept. 38, Springfield, Massachusetts

The Largest Motorcycle Manufacturer in the World



Powerplus
Model NE-20

Indian Motorcycle

For Sale by Dealers Everywhere

A pen
for every
writer

Fine, Medium,
Stub and
Ball Pointed

It's the special Spencerian steel and the finely worked, hand-made points that make Spencerian Pens last so long and write so smoothly. *Send 10c for 10 samples, different patterns.* Then pick a style that fits your hand. Use that style always. We will also include that fascinating book, "What Your Handwriting Reveals".

LANGUAGES QUICKLY LEARNED

THE LANGUAGE PHONE METHOD
and Rosenthal's Practical Linguistics
The war has created unlimited opportunity. Prepare now to better your position, or increase your income by learning the language you need at school. Write for Booklet and Free Trial Offer.
THE LANGUAGE PHONE METHOD
646 Putnam Bldg. 2 W. 45th St., N.Y.

FREE CATALOG Give name of school or club and number in class.

Either plain illustrated made with any equal amount of lettering, one or two colors enamel. Silver plate, 25¢ ea., \$2.50 doz. Sterling silver, 80¢ ea., \$8.00 doz. Over 350 attractive designs in our 1920 catalog. Write today for free copy. High grade Solid gold Pins and Rings.

W. L. BASTIAN BROS. CO. 169 Bastian Bldg., Rochester, N. Y.

This marvelous method fully outlined in an accurate, dependable, worth while book—"HOW TO STOP STAMMERING" Mailed on receipt of 10 cents. The HATFIELD INST: 169 N. Dearborn, CHICAGO

MANY people have homemade tool-boxes with the hinges for the cover set upon the top of the box. This feature encourages the thief, for by simply removing the hinges he has complete access to the contents. Why not set the hinges on the inside and insure your tools by making the box as nearly thief-proof as possible?

Inside hinges give the would-be thief a problem in trying to open your tool-box

Buy the ordinary long hinges and bend them in the manner shown at the top of the illustration. This enables the bent part of the hinges to fit snugly against the inside of the cover. Use short, heavy screws, setting them tightly into the wood. If preferred, the wood may be cut away so that the hinge centers will not show above the top of the cover.

EVERY poultryman, whether amateur or professional, knows how dark it is inside his incubator and how



Don't fumble around in the dark interior of an incubator with matches: attach a battery and light

difficult it sometimes is to read the instruments.

Why not rig up an ordinary dry battery, push-button, and 1.5-volt lamp, as shown in the illustration, and brighten things up inside?

The battery may be fastened either to the bottom or the side of the incubator, and the push-button to the front of the incubator.

The miniature lamp and receptacle are placed in the most convenient position inside.—F. C. VESEY.

YOU can now quickly qualify for a good paying job and a bright future in the Auto and Tractor field. At our great school you learn how to operate, adjust and repair all makes of AUTOS, TRACTORS, TRUCKS AND GAS ENGINES at a tuition easily within your reach. Write for facts today.

**Endorsed by Auto Factories,
Graduates and Students**

Thousands of our satisfied graduates have made good and are now earning big salaries. You can do it too. Our method of instruction is thorough and complete. You work with the actual tools and machines at this school under expert instructors.

Write for full particulars right away so you can start earning good money during the winter in the city or be ready for a spring job on the farm. Hundreds of other men are making good on the help The Milwaukee Motor ^{Co}chool gave them. Don't let your opportunity slip!

FREE A fine Kit of 29 tools worth \$17.50 is given to everyone who enrolls now. They are yours to take home with you. Send for our new **Free Book**—"Making You Master of the Auto." No obligation. Get full information. A letter or a postcard will do, but write at once.

MILWAUKEE MOTOR SCHOOL
Dept. 754 555 Downer Ave., Milwaukee, Wis.

LEARN MUSIC AT HOME!

Music no longer difficult
New plan makes it easy to
learn by home study. Posi-
tively easier than with pri-
vate teacher. Faster pro-
gress. You will be able to
play your favorite instru-
ment in a few short
months! More than 200,
000 men, women and chil-
dren have learned by our
method. You too can
learn in your spare time.
We guarantee it.

U. S. SCHOOL OF MUSIC
84 Brunswick Bldg. New York City

STORAGE BATTERIES FOR ANY CAR

Starting Lighting

**Guaranteed Nine to Eighteen Months
No False Promises. Performance Counts**

6 Volts rebuilt \$12 and your old battery or \$14.50 cash
12 Volts rebuilt 17 and your old battery or 19.50 cash
NEW C BOLT GUARANTEED 18 MONTHS \$\$\$

Economize in comfort with a BANNER BATTERY.
Send twenty per cent deposit, balance C.O.D. subject
to inspection.

BANNER BATTERY CO.
1356 Michigan Ave. Chicago, Ill.

Small Steam Engines and Boilers

 Gas and Gasoline Engines,
 H. P. up; Tanks, Pumps,
 Gear Motor Makers' Supplies
 Get Our Big Catalogue sent postpaid
 for 1c (coin placed) or stamps.
 Refunded first order. 192 Pages -
 Over 200 Illustrations.
**MODERN ENGINE
 & SUPPLY CO.**
 344 Lombard Block CHICAGO



THE ENCYCLOPAEDIA BRITANNICA

Furnishes Accurate Knowledge

On Every Subject Under the Sun

The World's Greatest Authority.

THE ENCYCLOPAEDIA BRITANNICA contains probably the best and most reliable information written by the greatest experts on practically every subject known to the human mind. No matter what subject you are interested in, no matter what subject your family or your children are interested in, no matter what subject comes up in your daily papers or your books, you will find that the Britannica gives the most comprehensive information in its 44,000,000 words. Every phase of a subject is covered. Even the smallest, most obscure information is in the Britannica, as well as the articles on the great general subjects.

When you read an article in the Encyclopaedia Britannica you feel confident that the information is reliable, for the Britannica is written by the wisest minds—each a specialist in the particular subject upon which he has furnished an article for the Britannica. These writers are either professors in the great institutions of learning in our country and other countries, or are scientific men and women who, by their superior intelligence and research, have acquired far advanced knowledge of their subjects, or, again, they are the great workers of the world. They write in a clear, concise manner which every member of your family can understand. You will be surprised how interesting and fascinating are the articles in the Britannica, and you will have many hours of profit and pleasure from a set of this great work.

Your Country Needs Your Help in the Solution of Her Post-War Problems.

Shall we retain our high tariff or shall we operate on a free trade basis? Shall we wipe out our enormous national debt in one or two

generations or shall we extend it over a comparatively long period? Shall we adopt universal training or maintain a large standing army? Shall this nation become more autocratic or tend toward Socialism? What will mean the greatest prosperity and happiness to the people?

You, as a citizen of this great nation, in the day of the greatest crisis of its history, should put yourself in a position adequately to answer and pass intelligent judgment on the questions that are so vital to the country and the happiness and welfare of its people.

Give Your Child a Fair Chance.

Who are the men and women in each generation who have stood head and shoulders above their fellow men and who have won the most notable success? They are the men and women who, as children, have educated themselves beyond the station to which they were born. Abraham Lincoln was the best educated lawyer in his town, and he continued throughout his life probably the best posted man of his day, because he read and read. You insist that your child has brains, but you should help that child develop his brains, and give him every advantage possible within your means, so that when he becomes ready to do his work in the world he is not handicapped by lack of education. Education is the path that leads to achievement, to a larger life and to greater success. Put in your child's hands the Encyclopaedia Britannica, the world's storehouse of knowledge, which has been the guide to the education of millions of men and women. It will inspire your child to learn, and it will furnish him with a great teacher on many thousands of subjects.

We Are Offering the Britannica at a Great Bargain

\$1 As First Payment brings you this Complete Set of 29 Volumes, Containing 44,000,000 Words, 30,000 Pages, 15,000 Maps and Illustrations. The Balance Is in Small Monthly Payments.

Sign and Send This Coupon Today.

Remember, this is an unusual offer of the Britannica printed on genuine India paper. Act today—NOW—by clipping the coupon and sending for the beautifully illustrated book telling all about the Britannica.

Sears, Roebuck and Co., Chicago, Ill.

Gentlemen: Please send me, free, your Illustrated Book No. 19C, giving full information about the new Encyclopaedia Britannica. Also tell me what I will have to pay for one of the remaining sets of the Handy Volume issue of the Britannica printed on genuine India paper.

Name
Postoffice
R. F. D. Box
No. State
Street
and No.

**Sears, Roebuck and Co.,
Chicago, Ill.**

Wire Insulation Made from Tire Filler

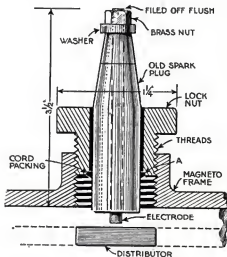
SOMETIMES a wire insulation has become so worn that the copper is exposed. A break of this kind cannot easily be wrapped with tape.

In such cases a small quantity of good tire filler worked into and around the chafed wire will make a fine substitute for insulation. Where double-contact lamps are used and the wires fit close together, as in the Ford type of headlight, the filler can be pressed around the wires and the cap screwed on. This also holds the wires firmly.

Repairing a Magneto with Spark-Plug Porcelain

TO repair a magneto that has a faulty brush-holder or "brush nipple," follow this simple and cheap method.

The brush-holder is usually made of rubber or composite, and is bored out in its center, the hole containing a carbon brush and a spiral spring for



How an old spark-plug porcelain can be inserted into a magneto to remedy short circuits from defective brush-holders

tension. Frequently this holder may fracture and its threads wear, or perhaps the bearing becomes so loose that rain water leaks past into the junction of the brush and armature. This causes a short circuit, which results in a defective engine.

An extremely efficient way to repair this defect is to remove the old composition holder and insert the porcelain of an old spark-plug with its lock-nut into the brush-holder. Ordinary cotton string may be used for packing, and the central electrode should be filed off to the proper distance from the magneto distributor, so that the spark is transmitted as before.

The electrode must just barely clear the brass of the distributor, and the adjusting may be done by more or less packing in the lock-nut shown at A.—P. P. AVERY.



*Perfect Soft Water
for
Industry and Home*

NATURE has revealed the means through which softening of water has been made practical for every use. Factories, shops and other industrial establishments now save literally millions of dollars that were wasted by use of hard water.

And for the home—greater comfort and refinement. Water as soft as falling rain yet free from the taint and odor and grime of roof and trees, water that is beneficial to skin and complexion, that leaves the hair fluffy and soft and comfortably clean—this you can now have, flowing to every faucet.

REFINITE
RIVAL OF THE CLOUDS

Nature's Water Softener

The Refinite Water Softener is a system perfected to utilize Nature's own water softening mineral, Refinite. It attaches to the supply pipe in the basement. Water needs only to pass through a bed of Refinite in this system to be freed of its troublesome lime and magnesium hardness.

In laundries and the laundry department of hotels, hospitals and institutions, Refinite soft water cuts the washroom supplies expense more than half. It fully doubles the life of linens; makes possible the laundering of woollens, silks and other delicate fabrics not commonly attempted. In textile mills it enables dyeing formulas to act dependably; improves the quality of the products. In steam power plants it prevents boiler scale, saving fuel, labor and equipment.

The Refinite system occupies little space—Requires no expert supervision—is easily installed—Very reasonable in price. There's one for your use. Let us tell you about it—no obligation. Address our nearest office.

THE REFINITE COMPANY
Refinite Building OMAHA, NEB.

Also Mfrs. of Refinite Rapid Pressure Filters



NEW YORK, 9 E. Fortieth St.
ATLANTA, 220 Hurt Bldg.
TORONTO, 21 Becht St.
CINCINNATI, 410 Thielman Bldg.
DETROIT, 225 Lincoln Bldg.

CHICAGO, 908 S. Michigan Ave.
MINNEAPOLIS, 420 Plymouth Bldg.
KANSAS CITY, 611 Grand Ave. Trust Co.
DENVER, 813 Montezuma Bldg.
SPokane, 1015 Old Nat'l Bank Bldg.

SAN FRANCISCO, 419 Call Bldg.
LOS ANGELES, 321 Bory Bldg.
PETERBURG, Thatcher Bldg.
BUFFALO, 411 Liberty Bldg.
SALE LAKE CITY, 209 Walker Bldg.

Getting a Heavy Barrel Up an Incline

ONE man can ordinarily handle a heavy barrel when it is on a level plane, but it is difficult to force it up an incline.

If a long rope is used as shown in the



No difficulty is encountered in pulling a barrel uphill if you use the method described here

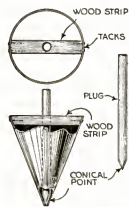
Illustration, the barrel can be readily moved.

The rope is doubled and fastened over an eye-bolt in the door-sill, the loops being passed around the barrel ends and the ends held by the operator.

With the help of this arrangement one man can pull a barrel up any angle of incline with very little effort.

Regulating the Flow of a Grindstone Lubricator

THE ordinary water-holder that is sold with every grindstone has no means of either regulating or stopping the flow of water.



Here's a way to control the water flow on that troublesome grindstone

The way to remedy this defect is to fasten a wooden strip across the top, boring the strip so as to permit the snug working of a wooden plug through it.

The plug is shaped to fit the bottom of the cone, similar to a needle valve in an automobile carburetor.

By raising or lowering the plug, the water in the grindstone's holder can be controlled at will.—JAMES M. KANE.



"Mr. Stephenson— meet Dr. Franklin!"

Chug, chugging along in his first rude steam locomotive, Stephenson did not look to "chained lightning" to render the invention safe and most widely useful.

Nor did Benjamin Franklin, as he flew his kite into the storm clouds, foresee how electricity would in a later day spur the "iron horse" on to greater achievements.

Yet today safety and speed in steam railroad operation are reconcilable only in proportion as electric signal devices are employed. Your protector is, ultimately, the electrical apparatus upon which every steam railway relies.

A railroad without telegraph or telephone would hurl itself into the scrap heap.

How else to reach out and warn a train rushing into unseen danger? How else quickly to spread the news of damage done by storm? How else to clear the tracks for the express which carries you onward to your journey's end?

All along the way, night and day, men are alert to shield you from harm. Train dispatchers, telegraph keymen, signal tower-men at every city and way station, have no other concern except to see you safely through.

So that your trip to New York, Chicago, or the coast is safer, quicker, pleasanter than ever Napoleon traveled in state from Paris to Marseilles.

Snugly quartered in a Pullman sleeper you command a thousand watchful hands and eyes for body-guards.

But their vigilance would accomplish nothing without equipment in perfect order. On such factors as the proper adjustment of a telegraph receiver and the responsiveness of an electric switch rests your "Safe Home."

That travel has been made secure today is a tribute to the excellence of electrical equipment no less than the skill of operation and the care of supervision that our steam railroads have consistently maintained.

Published in the interest of Electrical Development by an Institution that will be helped by whatever helps the Industry.

Western Electric Company

No. 4 So completely does this organization serve the electrical field that every time you call up your grocer, switch on a light or take a street car down town, the chances are you are making use of Western Electric equipment.



"I Can Succeed!"

"What other men have done with the help of the International Correspondence Schools, I can do. If the I. C. S. have raised the salaries of other men, they can raise mine. If they have helped others to advance, they can help me. To me, I. C. S. means 'I CAN SUCCEED.'"

Make up your mind right now that no other day shall pass until you have made your start toward success.

For 28 years men in offices, stores, shops, factories, mines, railroads—in every line of technical and commercial work—have been winning promotion and increased salaries through the I. C. S. More than 100,000 men and women are getting ready right now with I. C. S. help for the bigger jobs ahead.

No matter where you live, the I. C. S. will come to you. No matter what your handicaps, or how small your means, we have a plan to meet your circumstances. No matter what career you may choose, some one of the 280 I. C. S. Courses will surely suit your needs.

When everything has been made easy for you—when one hour a day spent with the I. C. S. in the quiet of your own home will bring you a higher income, more comforts, more pleasures, all that success means—can you let another single precious hour of spare time go to waste? Make your start right now! This is all we ask. Without cost, without obligating yourself in any way, put it up to us to prove how we can help you. Just mark and mail this coupon.

TEAR OUT HERE INTERNATIONAL CORRESPONDENCE SCHOOLS BOX 7672, SCRANTON, PA.

Explain, without obligation, how I can qualify for the position, or in the subject, before which I mark X.

- | | |
|--|---|
| ☐ Electrical Engineer | ☐ SALESMANSHIP |
| ☐ Electric Wiring | ☐ ADVERTISING |
| ☐ Telegraph Engineer | ☐ Window Trimmer |
| ☐ Telephone Work | ☐ Show Card Writer |
| ☐ Mechanical Engineer | ☐ Sign Painter |
| ☐ Mechanical Draftsman | ☐ Railroad Trainman |
| ☐ Machine Shop Practice | ☐ ILLUSTRATING |
| ☐ Toolmaking | ☐ Ceramics |
| ☐ Engine Operating | ☐ BUSINESS MANAGEMENT |
| ☐ CIVIL ENGINEER | ☐ Private Secretary |
| ☐ Drafting and Blueprinting | ☐ BOOKKEEPER |
| ☐ MINE FOREMAN or FINDER | ☐ Handwriting and Typing |
| ☐ Structural Engineer | ☐ Cert. Pub. Accountant |
| ☐ PLUMBING and HEATING | ☐ TRAFFIC MANAGER |
| ☐ Sheet Metal Worker | ☐ Railway Accountant |
| ☐ Textile Overlooker or Supt. | ☐ Commercial Law |
| ☐ SMITHRY | ☐ GOOD ENGLISH |
| ☐ Mathematics | ☐ Teacher |
| | ☐ Business School Subjects |
| | ☐ CIVIL SERVICE |
| | ☐ Railway Mail Clerk |
| | ☐ AUTOMOBILE OPERATING |
| | ☐ Navigation |
| | ☐ JOURNALISM |
| | ☐ Penmanship |
| | ☐ Penmanship |
| | ☐ Penmanship |

Name _____
 Present _____
 Occupation _____
 Street _____
 and No. _____
 City _____ State _____

Canadians may send this coupon to
 International Correspondence Schools, Montreal, Canada

How to Make a Mission Magazine-Stand

THIS cabinet is within the ability of any boy to make, and if care is taken in its construction, a durable and handsome piece of furniture will be the reward. The beauty of the arts and crafts design lies in the simplicity of line, good workmanship, and smooth waxed finish.

The following pieces of lumber will be required:

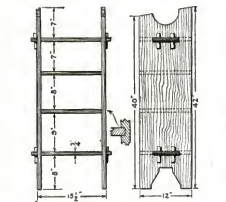
2 sides, $\frac{7}{8}$ in. by 12 in. by 42 in., sandpapered on four sides.

1 top shelf, $\frac{3}{4}$ in. by 12 in. by 15 in., sandpapered on two sides.

1 bottom shelf, 2 shelves, 1 in. by 12 in. by 14 $\frac{1}{2}$ in., sandpapered on two sides.

4 keys, 1 in. by 1 in. by 3 $\frac{1}{2}$ in., sandpapered on two sides.

The dimensions given are for the finished pieces, and the material can be ordered from any mill. If the amateur craftsman desires to cut up his own lumber, the dimensions must, of course, be enlarged a trifle to make proper allowance for squaring up the

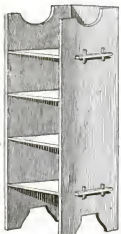


The scale diagram indicates the correct dimensions of each part

rough. As the most popular finish is gained by staining and waxing, white or red oak is the best wood to use. Ash also takes mission finishes well, and chestnut, while softer, possesses a beautiful grain, and may often be used to good advantage in making furniture of this character.

Begin the work by squaring up the joint edges and the ends, but do not cut the shelves to correct length just now. Lay out the outline on the side pieces by using a paper pattern, and carefully mark out the tenons.

Carefully study the scale drawings, which indicate the correct dimensions of each part. As shown, the top and lower shelves are tenoned through the



As the stand will appear when completed



\$200 Saved By This Home Lover

One housewife had selected \$500 worth of Furniture locally before learning of this new Larkin plan. The same selection of our low Furniture Plan, priced at her only \$350. Wouldn't you call this saving of \$200 worth while? May we send all the interesting facts?

800 Furnishings At 17c a Day —2 Years to Pay

Small as well as large Furniture needs are easily and quickly filled under this delightful plan. Two years time and payments as low as 17c a day. Completely furnished an entire home or parts of several rooms this convenient way.



Get This Big 104-Page Book FREE Here is a complete guide for locating your home. You'll find many profitable home looking over this Book of Better Homes. Write for it now. Find out how easily and economically your home can be brightened.

Larkin Co. Desk SP38 420 Buffalo, N. Y.



Factory

price direct to you

This \$12 Officer Shoe

Hand sewed.

First Grade

The factory price direct

to you at only

\$6.89

The retail price of this shoe is \$12.00. It is made in the best of the world's finest leather. Guaranteed to last the longest wear. Comfortable and easy to wear and we will send you them back. You don't have a cent.

If you are sending money order or check do not include postage. Pay only \$6.89 for shoes. We pay postage. State size.

These shoes are built to be good for work and dress at the same time.

U. S. National Army Shoe Co.

Dept. P.M. 795, Westfield, Mass.

What 15 Cents will bring you From the Nations' Capital

The little matter of 15 cts. in stamps or coin will bring you the *Futbinder* on trial. The *Futbinder* is an illustrated weekly, published at the Nation's center, for the Nation's paper that prints all the news of the world and tells the truth and only the truth; now in its 27th year. This paper fills the bill without comprising the paper's costs but \$1 a year. If you want to keep posted on what is going on in the world, at the cost of 15 cts. a week, or the expense of time or money, read the *Futbinder* in the morning. It is the lifting of the paper you want a paper in your house which will tell the world's news, reliable, enterprising, and complete. If you would appreciate a paper which prints everything clearly, briefly, and to the point, send us to show that you might get such a paper, and we will send the *Futbinder* on probation 13 weeks. The 15c does not repay us, but we are glad to have in new friends. THE PATENTERS, Box 923, Washington, D. C.

Send for a Complete Catalogue of MASONIC BOOKS Jewelry and Goods REDDING & CO. Publishers and Manufacturers

200 Fifth Avenue Dept. S New York

BUCHSTEIN'S FIBRE LIMB

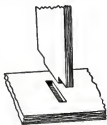
soothing to your stump—strong, cool, neat, light.

Easy payments.

Guaranteed 5 Years. Need not Cutting Today.

P. BUCHSTEIN CO., 113 6th St. S., MINNEAPOLIS, MINN.

sides. A good way to mark this out is to place the shelves on the bench with face edges uppermost and the ends even. Lay the square across and run a pencil line around the edges to get the width between the sides. Now take each piece in turn and pencil a mark entirely around it. Having marked out the tenons, and the square mortises for the keys, carefully chisel out the mortises and saw out the tenons.

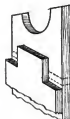


When this is done, lay the key or wedge can be made in several forms the shelf on the side-piece, and, using the tenon for a pattern, mark out the outline for the mortise in the side pieces directly from the tenon. This will prevent any possibility of a mistake.

The mortises should be carefully cut, and there are two ways of doing this. One way is to chisel out the entire mortise; the second to bore a number of connected holes with a bit and chisel out to the lines. In cutting mortises, take care to keep the sides sharp and clean. Do not attempt to chisel more than half way through on one side, but turn it over and cut through from the opposite side. By doing this, a clean mortise is obtained without danger of splitting or marring the edges.

The middle shelves are merely let into the sides about $\frac{1}{2}$ in. That the grooves may not show, a shoulder is cut about $\frac{1}{2}$ in. back from the edges.

The key or wedges may be made in several forms, but the plain tapered key is very good, and is mostly used. Whatever the shape of the key employed, it is well to remember that the taper of the key where it passes through the tenon must be made the same size as its mortise.



The cleats are first measured, then cut as shown here

Sandpaper well, using No. 1 paper, and finish up the work with 00 grade, until all surfaces are clean and smooth.

For finishing, any one of the many mission stains may be used. A very nice brown may be obtained by using one part of Flemish water stain in four parts of water. Brush this on and let it dry. When dry, go over lightly with 00 sandpaper, but do not cut through the stain. A coat of dark brown filler is now applied, according to the directions on the label of the can. Let this stand until the gloss disappears, then wipe off with a cloth, crosswise with the grain. The next day the final finish of wax is applied. Rub the wax well into the wood with a cloth and polish.

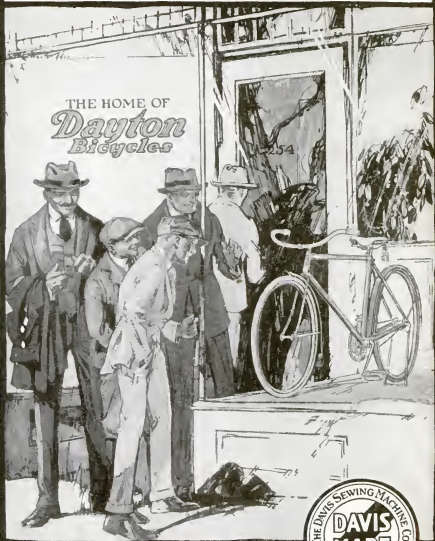
Dayton Day

will be celebrated by Dayton dealers throughout the United States, on

Friday, April 23

marking the 25th anniversary of

Dayton Bicycles



Visit Your Dayton Dealer

TWENTY-FIVE YEARS AGO — the first Dayton Bicycle was shipped from the Davis factory.

On Friday, April 23, Dayton Dealers, everywhere, will keep open house in observance of the Dayton's 25th anniversary.

You are invited to visit the Dayton dealer in your community. It will be well worth your while to enjoy your dealer's

hospitality, and, in viewing his display of new 1920 Dayton models, see for yourself the high point in development and refinement that Dayton has achieved through a quarter-century of effort. There will be something interesting for everyone.

Consider well what a Dayton can do for you — can save for you. Write today for new catalog illustrating 8 fine 1920 models for boys, girls, men and women. Ask for your dealer's name and Catalog No. 44.

A bicycle is the cheapest and healthiest known means of transportation
Cycle Dept., THE DAVIS SEWING MACHINE CO., Dayton, Ohio

"Ride a Bicycle"

inside patch has to be applied. I cut out a stiff piece of cardboard (Fig. 5) larger than the circular piece of cloth, then cut a slot and central opening to allow it to pass by the umbrella rod. I then slipped this disk between the fabric and the ribs (Fig. 6), which gave me a good base on which to iron the patch into shape.

This repair, when properly made, is waterproof and will save many an umbrella going to the trash pile.—JAMES M. KANE.

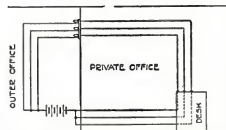
To Make a Deep Hoe from an Old Shovel

A HOE suitable for handling and cutting small irrigation ditches, digging trenches for deep planting, and like purposes can be easily made from an old shovel.

Remove the shovel from the handle by driving out the rivets, and heat the shank of the shovel blade in a forge or coal fire. When red, bend the shank at right angles and allow it to cool. Then replace the handle, and a good serviceable hoe is the result. A round-point shovel is best for this purpose.—WINDSOR CROWELL.

Electric Lights to Call Employees

THE manager of a well furnished modern office found that the sound of the call-bell which he rang for the stenographer, office-boy, or clerk was a source of annoyance to himself and callers to his office. He therefore installed a battery and a set of small electric lights in the outer



Instead of an annoying bell the flash of an electric light calls your employees to your desk

office, which were regulated by means of push-buttons placed on his desk.

In installing such an outfit small 4- to 6-volt lamps and a battery of four dry-cells may be used. The lamps may be placed on a panel in the main office, each lamp designating some particular employee; or if preferred the lamps may be placed on the desks of the employees.

The wiring diagram is only suggestive. The wires may, of course, be concealed.—FLOYD L. DARROW.



Nothing to do till next Monday

WHAT'S more, when you have a 1900 Cataract Electric Washer, you finish the wash bright and early each Monday!

Do you know why?

It's because of the magic figure 8. In the 1900 Washer the water is forced through the clothes in a figure 8 movement, four times as often as in the ordinary washer. Thus it washes the clothes faster. In fact, it is this magic movement that makes the 1900 the perfect washing machine.

You can wash everything in your 1900, for there is not a single part in the tub to cause wear and tear, or to pull off buttons. The water is forced through your clothes entirely by the action of the tub, not by the action of any parts in the tub. When you have finished the wash, there are no parts to lift out and clean either.

The 1900 works easily, smoothly, and at a cost of less than 2c an hour. It washes the clothes snowy white and clean in 8 to 10 minutes.

The wringer also works electrically, and can be moved from the washer clear around to the clothes basket without moving the washer an inch.

The water swirls through the tub in a figure 8 movement four times as often as in the ordinary washer.



Comes in 8 and 12 sheet sizes.

Our Special Trial Offer

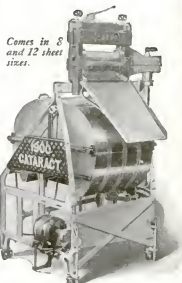
You may prove to yourself that the 1900 is the perfect washing machine. There is a 1900 dealer near you who will gladly demonstrate a 1900 Cataract Washer right in your own home. Then if you wish, you may start paying for it on terms to suit your convenience. Remember, we also have washing machines operated by hand and water power.

Write us today for the name of the nearest 1900 dealer and a copy of the book, "George Brinton's Wife." It's a story you will enjoy. Molly, his pretty little wife, had troubles of her own until she interrupted a bridge party, and then things began to happen.

1900 CATARACT WASHER

1900 WASHER COMPANY
206 Clinton St., Binghamton, N. Y.

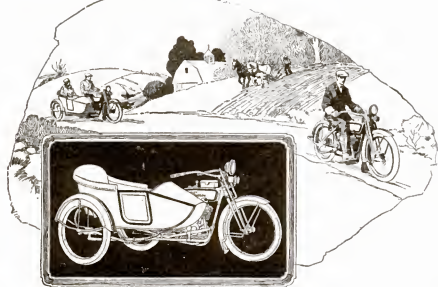
Canadian Factory and Office:
CANADIAN 1900 WASHER COMPANY
357 Yonge St., Toronto



Just connect it with the electric light and off it starts.

1900 WASHER COMPANY
206 Clinton St., Binghamton, N. Y.
Please send me the name of the nearest 1900 dealer and a copy of the story, "George Brinton's Wife."

NAME _____
ADDRESS _____
CITY AND STATE _____



OVER the hills to the country—far from the Job and the City! Not just once in a long while, but every Sunday or every evening if you like, when you have a Harley-Davidson!

Miles are mighty short, and trips are very cheap, when you have a "World's Champion" to whisk you there and back.

Forty to sixty miles on a gallon of gasoline, with tire and other upkeep costs low in proportion.

Ask Your Dealer About His
Easy Payment Plan

HARLEY-DAVIDSON MOTOR CO.,
MILWAUKEE, WISCONSIN.

Harley-Davidson
"World's Champion"

**RAILWAY
TRAFFIC
INSPECTORS
ASSOCIATE
WITH
BIG MEN**

That is what gives them chances for promotion. They start in at a good salary—\$10.00 a month and expense.

The work is important, for the safety of thousands depends on their vigilance. And when they do their work as we teach them they attract the favorable attention of their superiors. Promotions then are rapid.

Learn This Profitable Profession

All you need is a common school education for entrance to our three-month's course, which is easy to learn at home during your spare time. Take the initiative now, while the demand for Railway Traffic Inspectors is so good. THERE IS A BIG DEMAND IN THIS FIELD.

We know of fine openings for our graduates. Many who entered our course a few months ago now hold positions.

OUR BROOKLET tells of this ideal vocation in the big out-doors—how you associate with big men—how you can earn an excellent salary from the start—how you can climb to the very top. The opportunity COUPON (below) is your key to a better salary now and a much bigger future. Why not send it today! Remember, you select at \$10 a month, and WE SECURE YOUR POSITION.

Standard Business Training Institute,
BUFFALO, N. Y.

Please send, without obligation, to me, your **Brooklet D-3**, explaining your Railway Traffic Inspectors' Course.

Name _____
Address _____

**WE
ARRANGE
FOR A
POSITION**

**Tire Repairing
Learn a Profession**

**Earn from \$300 to \$600
a month**

Be a Tire Expert, we teach you free at our school or by mail. Thousands are getting in now. Locations everywhere.

Badger SERVICE STATIONS

Badger TIRE REPAIRING

Service Stations

We Put You In a Paying Business of Your Own Right from the Start

Small investment may mean a fortune to you in a short time. It assures you a large profit in a growing profession.

Remember—have your tires and tubes repaired by the **Badger Method Tire Repairing**—the only method which will mean more tire miles to you. Badger Method Tire Repairing Service Stations everywhere.

Write today for complete outline and particulars of our **Badger Method** and how to open a **Badger Service Station**.

Tire Repair Equipment Co.
220 Johnson St.
Arlington Wisconsin

A New Kind of Index for the Photo-Plate File

THE subject matter of a photographic plate stored away in a rack is usually unknown unless the plate is removed and held to the light. But with the index shown in the illustration fitted to the plate-rack the nature of any plate in it may be seen at a glance.

Two large metal tabs hang at the side of the rack drawer, which is equipped with a carrier so that it may

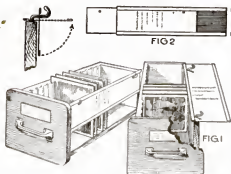


Fig. 1 shows how the description is aligned opposite its plate; while Fig. 2 shows the method of slipping a card into its proper place

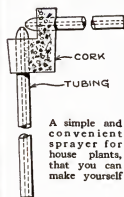
be drawn out all the way. Slips of paper, each one carrying a description of a plate, are fitted in each tab.

When the rack is drawn out and the tab lifted, as shown in Fig. 1, each description lies directly opposite its plate. The tabs swing on two wire hooks which are screwed into the framework of the rack.

These tabs are made of sheet tin, and, when necessary, may be lifted from the rack. The method of slipping the paper into the tab is shown in Fig. 2.—EDWARD R. SMITH.

Make a Sprayer for Your Indoor Plants

IT is advisable frequently to spray window-garden plants in order to give the leaves, stems, and flowers



A simple and convenient sprayer for house plants, that you can make yourself

water in a finely divided state just as nature does when a thick fog covers everything with its wet blanket.

A small and simple sprayer can easily be constructed.

This consists of two tubes and a cork. For the tubes take two

lengths of goose-quills, straws, or thin glass tubing. Cut a section from the cork as illustrated, and bore two holes through the cork at the cut ends and

at right angles to each other. Now push the tubes through the holes until they meet, being careful to have one tube slightly above the other.

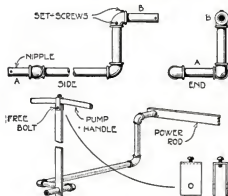
To use the sprayer, place one tube in a glass of water and the other against the lips. If a draft of air is now blown through the tube a partial vacuum will be produced in the other tube, causing the liquid to rise in the tube and be projected from the nozzle in a fine spray.—ERNEST BADE.

A Reciprocating Pump-Jack Made of Pipe-Fittings

A PUMP-JACK for small pumps can easily be made of common pipe-fittings. It is of a reciprocating nature, and will operate a pump at a considerable distance from the source of power. The diagram illustrates its construction.

A long piece of pipe the desired size constitutes the main or horizontal shaft. To this you attach lengths about a foot long, one to each end, by elbows, so that one is vertical and the other horizontal (A and B).

To these projecting pieces, at right



You can make your own reciprocating pump-jack from discarded pipe-fittings

angles to them, elbow short nipples, and the jack is done. Simply provide set-screws at each elbow, so the threads will not start because of the strain put upon them when under load. Also drill a hole in the end of each nipple for cotter-pins.

Set the jack at the base of the pump at right angles to the pump handle in suitable bearings.

The vertical arm is attached to a wooden rod, as shown, which goes to the pulley wheel on the motor or counter-shaft, and is attached to it eccentrically, like the connecting rod of an engine. The horizontal arm is attached to the pump handle by a second wooden rod. A metal clamp, as shown in detail, serves to hold it firm and allows it to be shifted along the pump handle, thus varying the stroke. Cotter-pins keep these rods from running off.

As the power rod moves backward and forward it lifts and lowers the horizontal arm. This operates the pump handle and also pumps the water.—WINDSOR CROWELL.



Those White Teeth

Ask People How They Get Them

All Statements Approved by High Dental Authorities

Millions of teeth are being cleaned in a new way. You see them everywhere—white, glistening teeth.

Ask about them. The owners will tell you, probably, that they use Pepsodent. They have found a way to fight the film which causes most tooth troubles.

Millions have already proved it. Leading dentists everywhere advise it. And over 6,000 new people daily write us for a 10-Day Tube.

Why Teeth Discolor

A viscous film forms on the teeth and coats them. You can feel it with your tongue. Modern dentists know this film to be the teeth's great enemy.

It clings to teeth, enters crevices and stays. The tooth brush does not end it. The ordinary tooth paste does not dissolve it. So it remains to do a ceaseless damage, until removed by cleaning in a dentist's chair.

Film is what discolours—not the teeth. It is the basis of tartar. It holds food substance which ferments and forms acid. It holds the acid in contact with the teeth to cause decay.

Millions of germs breed in it. They, with tartar, are the chief cause of pyorrhea. So, despite the tooth brush, all these troubles have been constantly increasing.

Now We Combat Film

Dental science, after years of searching, has found a way to combat film. Five years of careful tests have proved this beyond question.

The method is now embodied in a dentifrice called Pepsodent. It complies in all ways with modern dental requirements. And a 10-Day Tube of this tooth paste is now sent free to anyone who asks.

Let Your Mirror Tell

Make this free test. Look at your teeth now, then look in ten days. Let your mirror tell the story.

Pepsodent is based on pepsin, the digestant of albumin. The film is albuminous matter. The object of Pepsodent is to dissolve it, then to day by day combat it.

Science has lately made this method possible. Pepsin must be activated, and the usual agent is an acid harmful to the teeth. So it long seemed barred. But a harmless activating method has been

found, so active pepsin can be every day applied.

Send the coupon for a 10-Day Tube. Note how clean the teeth feel after using. Mark the absence of the viscous film. See how the teeth whiten as the fixed film disappears.

The results are quick and evident. They are all-important. You will never go back to old methods when you know them. For the sake of cleaner, safer teeth cut out this coupon now.

Pepsodent PAT. OFF.
REG. U.S.

The New-Day Dentifrice

The scientific film combatant, now advised by leading dentists everywhere and supplied by druggists in large tubes.

Ten-Day Tube Free

THE PEPSODENT COMPANY
Dept. 165, 1104 S. Wabash Ave.
Chicago, Ill.

Mail 10-Day Tube of Pepsodent to

MULLINS

STEEL BOATS CAN'T SINK

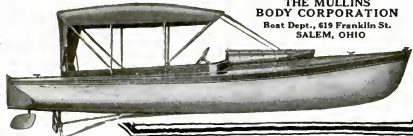
Write for catalog showing more than 40 models of steel and wooden power boats, rowboats and canoes.

Safe for you or your family. Buoyant air compartments like a life boat and strong steel hulls. Mullins Steel boats can't warp, leak, waterlog, dry out or open at the seams. No calking required, no boat house needed.

Designed by America's foremost naval architects—built in the world's largest boat shop. More than 70,000 now in use.

Mullins power boats have the best marine motors. Quiet, vibration-free operation is insured by the Mullins patented silent under water exhaust.

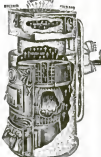
THE MULLINS
BODY CORPORATION
Boat Dept., 615 Franklin St.
SALEM, OHIO



1/2 SAVED GET OUR BIG BOOK

DO YOUR OWN PLUMBING AND HEATING AT LOW COST

Send for our big instructive 256 page Handy Man Book catalog. Every home owner, farmer, contractor, etc., needs it. Shows over 10,000 fixtures and supplies in plumbing and heating at wholesale, how to save skilled labor and unnecessary material, by our new



CUT-TO-FIT METHOD

Besides being our wholesale catalog this instructive Plumbing and Heating encyclopedia helps you select and install the proper PLUMBING WATER SYSTEM. HOT AIR, WATER OR

STEAM PLANT, has many plans, diagrams, sketches, elevations, etc., plainly showing how to do the work, this newer easy way with the aid of this

BIG HANDY MAN BOOK

We have spared no effort and have gone to a great expense to compile this practical book and to eliminate broadcast circulation, we request a deposit of 25 cents which will be refunded on first order, or send for our free booklet.

HARDIN-LAVIN CO.

44 Years at
625-364 Cottage Grove Avenue, Chicago
\$500,000 Plants Behind Our Guarantee.

AN EASY WAY TO MAKE MONEY

Don't be content to shod along on a small salary. Be independent. Go in the tire repairing business. One man says "I made \$80.00 the first day." Others average \$200 to \$500 a month. Very little capital needed. Job plentiful. Every motorist a possible customer. No experience needed. We teach you. Requires no watching or resupplying.

SHALER Tire Repair Outfit

Improved Wagon Tread Method
Used by Tire Manufacturers

Does as good work as the big high priced vulcanizing outfit. A boy can use it. It's the only vulcanizer that has Automatic Heat Control, and can't undercure or overcure a tire. Requires no watching or resupplying.

FREE Book

"How to Open a Tire Repair Shop." It tells how to make big money. Don't delay. Write quick.

C. A. SHALER CO.

2115 Fourth St. Wagon, Wisconsin



90 to 125
Miles on
a Gallon
of Gasoline!

The Shaw Motorbicycle

A high-grade, easy running, speedy motorbicycle of dependable power at a saving of from a third to a half in actual money. Equipped with 2 1/2 H.P. Motor, famous Breezer carburetor, high tension magneto, Automatic lubrication, Chain drive. Simple, efficient control at all times. Thousands in use.

Write today for prices and terms, also about the Shaw Automobile—like any other.
SHAW MANUFACTURING CO.
Dept. 364, CALESBURG, KANS.

AGENTS 500% PROFIT

Gold and Silver Sign Letters

For store fronts, office windows and glass signs of all kinds. No experience necessary. Anyone can put them on and make money right from the start.
\$40.00 to \$100.00 a Week!

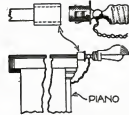
You can sell to nearby trade or travel all over the country. There is a big demand for window lettering in every town. Send for free samples and particulars.

Liberal Offer to General Agents.

METALLIC LETTER CO.
4334 North Clark Street, CHICAGO, ILL.

Don't Buy an Expensive Piano Lamp; Make One

ANY serviceable piano lamp may be made from a thin strip of mahogany about 19 in. long and an electric lamp-socket.



Here is a homemade piano lamp that cannot scratch the piano or fall from it

Cut the strips as shown in the illustration. No measurements can be given, because pianos differ in construction. After the strips are nailed together they are

sandpapered and varnished. The lamp-socket is attached to the right end, as shown, and wired to a convenient plug. Strips of felt are glued beneath the holder so that it cannot scratch the varnish at any place.—ROBERT SCHMITT.

Do You Know These Things About the Oiling System?

MAKE sure the oil-gage on your automobile is free to move, as a wrong indication is serious. Sometimes the wire is bent, and the gage does not fall as the oil is used up. The inexperienced driver does not realize this and his engine runs dry.

A gage ought to be within reach, so it may be tested by moving up and down. It gives a striking object lesson when the oil-base has not been cleaned for several thousand miles. On pushing the float down into the heavy oil muck at the bottom, it stays there, showing the need of a thorough cleaning.

Few people realize that oil deteriorates under heat, and that the spoiled oil in the crank-case thickens, accumulating carbon from the cylinders and making a thick, pasty mass that will not pass through the pump.

When necessary to change the oil, say every thousand miles, it should be drained out carefully. Some of the muck remains and mixes with the fresh oil, reducing its lubricating qualities. This is unavoidable unless the crank-case is removed for cleaning.

It is dangerous practice to put kerosene into the crank-case and then to run the engine to cut the muck and so drain it out with the kerosene. The bottom of the oil-base is covered with grit, metal chips, and other fire-grinding material which will be stirred up and forced into the bearings. To avoid this, remove the oil-base and clean it by hand.

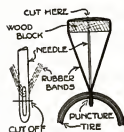
Check-valves, which control the flow of oil in a plunger type of pump, should be cleaned occasionally to insure proper working. When the oil does not flow or the gage shows no pressure, it may be because the pump is air-bound; usually cleaning the check-valves removes the trouble.

WINDOW SIGNS



Repair Your Bicycle Tires at Small Cost

NEXT time you get a tire puncture, don't go to a bicycle store and pay a high price to have it repaired. Try this simple expedient. Get a



No need to go to a vulcanizer with your punctured tire. Here's a quick way of fixing it

large darning-needle (the larger the better), and file off the end near the top of the eye. Press the pointed end of the needle into a block of wood about three inches square and an inch thick.

Take a handful of elastic

bands, and pass as many as you can through the crotch in the needle and around the block of wood. Put some rubber cement in the hole to be fixed, and push the filed end of the needle in the puncture as far as it will go. With a sharp knife cut the rubber bands across the back of the block of wood.

When this is done, the rubber bands will contract and the ends will stick out of the puncture.

The next step is to apply a lighted match to the projecting bands so they will melt and fill up the puncture. In a few minutes, when the rubber is cooled sufficiently, the tire can be inflated.

Very large holes and rips cannot be patched in this way, because the crotch of the needle will not hold enough bands to fill the hole or rip.—ARTHUR GOLDENBAUM.

Some Practical Uses for the Magnet

A SHORT time ago somebody gave me a horseshoe magnet taken from the ringer of a telephone. I didn't know just how I could use it, but it has proved useful in a number of ways.

When I spill a box of nails in dirt or shavings, instead of picking them up by hand, a long and tedious job, I just take the magnet and pick them up in a hurry.

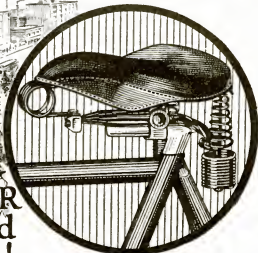
Sometimes, in working around a machine, I drop a screw or piece of metal into a difficult place. The magnet picks it up instantly, saving much time and bother.

When a nut drops into an automobile's crank-case or transmission, I simply make use of the magnet to remove it. Otherwise I would have to fish around with a wire for an hour or two before I could catch the nut.

These are only a few of the many uses for a magnet. Get one and see how quickly you can locate that unseen piece of metal that is delaying your work.



Here's YOUR Seat to and From Work!



Tiresome strap-hanging is *avoided*—boosted trolley fares *saved*—comfort and health *promoted*—lost time *done away with*—when you sit in the easy saddle of a 1920

Columbia

BICYCLE

This American family's time, money, and health saver is *soon paid for with saved trolley fares and a nest-egg started.*

Swift, smooth-running, lightweight but powerfully strong, trim, and equipped with the absolute best of everything, you will find the Columbia the favorite wherever those who work with hand and brain have investigated bicycle values.

Your local dealer will gladly explain the superiority of the 1920 Columbia and its many big features. See him *today* and *start saving.*

Sena for 1920 Columbia Catalog, showing models and types for everybody, all at reasonable prices.



WESTFIELD MANUFACTURING CO.
45 Lozier Ave., Westfield, Mass.

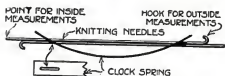


Ride a Bicycle

Calipers for Inside and Outside Measurements

ON a certain job it was necessary to find accurately a number of both inside and outside measurements. Not having calipers at hand, an improvised tool was made.

A piece of clock-spring seven inches long was obtained, likewise two darn-



A piece of clock-spring and two darn-needles make a pair of calipers for inside and outside measurements

ing needles. In each end of the spring was cut a long hole just large enough to take two needles.

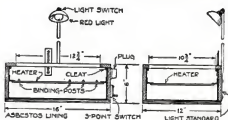
Hooks were bent on one end of each needle by heating, and both were placed in the holes in the spring, as shown in the sketch. The tension in the spring held the needles together until the measurements could be taken down.—DALE VAN HORN.

A Tray-Warmer for Amateur Photographers

THERE are many occasions when the photographer, either amateur or professional, constantly has to heat his developer or other solutions so his pictures will come up properly. This results in loss of time and fluctuations in temperature that tend to impair the quality of the work.

The electric heater shown herewith is designed to accommodate the standard size trays, and it will keep the solutions at the desired temperature under most conditions.

First build a box of matched lumber, using $\frac{1}{2}$ -in. stock. Build it 16 in. long, 12 in. wide, and 6 in. deep, out-



Showing the apparatus in detail with all parts marked to scale

side measurements. Leave the top open. Line the inside with asbestos paper and carry it up to the top edges.

The tops are built of narrow strips of wood $\frac{1}{2}$ in. thick, and mitered at the corners like a picture-frame. The sketch shows how they nest inside of each other, so any size tray can be used. Build the first or largest one 16 by 12 in., with the opening $10\frac{3}{4}$ by $12\frac{3}{4}$ in. The second one should fit snugly in the first, with an opening $8\frac{1}{2}$ by $10\frac{1}{2}$ in. The third top fits in

FOR
MEN
AND
WOMEN

W. L. DOUGLAS

"THE SHOE THAT HOLDS ITS SHAPE"

\$7.00 \$8.00 \$9.00 & \$10.00 SHOES

BOYS'
SHOES
\$4.50
\$5.00
\$5.50

W. L. Douglas shoes are sold through 107 of our own stores direct to the wearer at one profit. All middlemen's and manufacturing profits are eliminated. W. L. Douglas \$9.00 and \$10.00 shoes are absolutely the best shoe values for the money in this country. W. L. Douglas name and the retail price stamped on the bottom guarantees the best shoes in style, comfort and service that can be produced for the price.

Stamping the price on every pair of shoes as a protection against high prices and unreasonable profits is only one example of the constant endeavor of W. L. Douglas to protect his customers. W. L. Douglas name on shoes is his pledge that they are the best in materials, workmanship and style possible to produce at the price. Into every pair go the results of sixty-seven years experience in making shoes, dating back to the time when W. L. Douglas was a lad of seven, pegging shoes.

W. L. Douglas shoes are for sale by over 9000 shoe dealers besides our own stores. If your local dealer cannot supply you, take no other make. Order direct from the factory. Send for booklet telling how to order shoes by mail, postage free.

CAUTION—Insist upon having W. L. Douglas shoes. The name and price is plainly stamped on the sole. If it has been changed or mutilated, BEWARE OF FRAUD.

The quality of W. L. Douglas product is guaranteed by more than 40 years experience in making fine shoes. The smart styles are the leaders in the fashion centers of America. They are made in a well-equipped factory at Brockton, Mass., by the highest paid, skilled shoemakers, under the direction and supervision of experienced men, all working with an honest determination to make the best shoes for the price that money can buy. The retail prices are the same everywhere. They cost no more in San Francisco than they do in New York.

President W. L. DOUGLAS
SHOE COMPANY,
124 STATE STREET,
BROCKTON - MASS.

ALADDIN Homes

READI-CUT

SAVE \$300 to \$500

AVOID LUMBER SHORTAGE

Lumber shortage—a virtual famine of lumber—exists in many parts of the country. Reports indicate that it is impossible even now to get material for certain needs. Stocks were never so low as they are at present. The demand was never so great as it is now. *This Means Still Higher Prices.* It means that prices will go up rapidly—that it will possibly take \$100 in six months of a year to buy \$100 worth of lumber. Will you be forced to pay these prices? Will your need of a home in six months cost you a 50% or 100% penalty?

BUILD NOW delivery. Aladdin Homes are assured a big saving—from \$100 to \$1,000. *Big quick action is necessary.* The enormous demand for homes will soon fill the Aladdin mills to capacity. Your order will be the last. An important message to every builder is contained in the Aladdin Catalog. It is the message to you from the World's greatest home building organization.

NATIONAL SERVICE

Aladdin Mills are located in Michigan, North Carolina, Wisconsin and Oregon. The Aladdin Lumber Company has a great quantity of lumber in stock in all parts of the country for every need. The possible lumber famine predicted in all parts of the country will not affect the Aladdin Company. Every Aladdin Home manufactured in 1919 will be put up quickly and competently. No shortage will lawfully reduce the material from the Aladdin Home order.

Aladdin Homes are cut to fit as follows: outside and inside finish, doors, windows, sashes, built-in and exterior hardware, locks, nails, joints and all ready to erect. Send today for the Aladdin Home, No. 1275.

The Aladdin Company, Bay City, Michigan
Wilmington, North Carolina Portland, Oregon
Branches: Bellingham, Minneapolis, Toronto, Ontario, Canada

No Other Typewriter Can Do This:
MULTIPLEX HAMMOND'S
 Instantly interchangeable type
 Many styles, many languages
 Two types of languages always in the machine
Just turn the knob to change



The World's Most Wonderful "Writing Machine"

Here's a polyglot machine that writes all languages from Eskimo Indian to Sanskrit Japanese and over 365 different type-sets. The type is instantly interchangeable—two different languages or type sets are always on the machine. You "Just turn the knob"—to change language or type.

**Hammond
MULTIPLEX**

"Many Typewriters in One"

Sounds like an Arabian Nights story but the machine itself is very practical, very real. It is the typewriter President Wilson uses personally—the typewriter he took with him when he visited King George.

Types for all purposes
and for all languages

Spacing to suit size of type
Perfect alignment

Automatic Type Impression
All on one MULTIPLEX

The marvelous INSTANTLY interchangeable type feature is only one of the many reasons why thousands of prominent men and women in all walks of life prefer and personally use the Multiplex.

Write today for FREE BOOKLET

It will show you how, with the Multiplex you can put the force of emphasis into your typed matter—how you can write home with strength and to the fullness of your argument—how you can write with the means convincing force that you use in speaking—an exclusive feature of the Multiplex.

Write your name, address and occupation on the margin of this page NOW and mail to:

HAMMOND TYPEWRITER CO.
 639 East 69th St. New York City

Also an Aluminum PORTABLE Model. 11 lbs. Full capacity. Ask for special folder.

World's Best Roofing

at Factory Prices

"Reo" Chester Metal Shingles, V-Crimp, Corrugated, Standing Seam, Painted or Galvanized Roofing, Siding, Weathered, Paints, etc., direct to you at Rock-bottom Factory Prices. Write for greatest use offer ever made.

Edwards "Reo" Metal Shingles
 cost less: estimate three ordinary roofs. No painting overalls. Guaranteed not to dry, rust, lightning proof.

Free Roofing Book
 Get our wonderfully low priced and free samples. We will direct to you and save you all in-between dealer's profits. Ask for Book No. 498

LOW PRICED GARAGES
 Lowest prices on Ready-Made Free-Proof Steel Garages get one anywhere. Send postal for complete book showing the best.

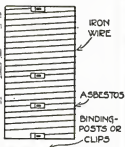
THE EDWARDS MFG. CO.
 445-459 5th St., Cincinnati, O.

the second, and has an opening $5\frac{1}{2}$ by $8\frac{1}{2}$ in. The opening in the fourth section should be $4\frac{1}{4}$ by $5\frac{1}{4}$ in. Thus the different openings will take trays of the following sizes: 10 by 12 in., 8 by 10 in., 5 by 7 in., and 4 by 5 in. These are the sizes generally used by photographers.

Place four little lugs of metal around the sides of the tops so they will rest on the edges of the top into which they may be inserted and kept flush with each other, forming a continuous top over the box. Nail little strips of wood along the under side of the 12-by-16-in. top piece to keep it from sliding off the edge of the box.

Attach a thermometer to the inside of the back of the box so the bulb is set down below the edge about 2 in. and the numbers between 60 and 75 can be read when the top is in place. A notch in the edge of the top cover will be necessary to clear the thermometer when the top is put in place.

The heater is composed of a sheet of thick, stiff asbestos wound with iron wire. Cut the asbestos so that when placed in the box its edges clear the sides of the box by at least one inch. Wind it with iron wire so no two turns touch. The amount of wire to use can only be determined by experiment, as the size of the wire makes considerable difference. Wind it closely at first, and connect one end to the binding-post which is inserted in the asbestos.



The heater is composed of a sheet of thick, stiff asbestos wound with iron wire

Connect one electric wire to this binding-post and place the other at different points along the wire until it becomes too hot to touch.

Now place a binding-post at that point and connect to that point and connect to that point. Then place another binding-post beyond that one and a fourth one at the end of the asbestos. Rivet four small angles of metal to the asbestos and to the inside of the box half way between top and bottom. See that no portion of the wiring on the heater touches the box or electric wires except at the four binding-posts.

Fit a plug receptacle and a three-point switch to the right-hand side of the box and connect up as indicated in the sketch. One terminal goes to the lever of the switch; the other direct to the binding-post on the heater. Then each point of the switch is wired to the binding-posts as shown.

An electric light standard can be bolted to the back of the box and fitted with a 4 C.P. ruby bulb if desired. This should be wired direct to the plug circuit as shown. It will be an additional con-

First aid in every household —Musterole

Cough, cough, cough. How it racks little Dorothy and passes on to mother and grandma and holds a croup danger for all the little ones!

Hurry, there, with the Musterole, that pure, white ointment that is better than a mustard plaster—and it will not bring a blister. Massage it gently over the chest and neck. Feel the tingle, then the cool delightfulness as Musterole searches down. It will penetrate, never fear. It will rout that old congestion clear away.

Musterole is a pure, white ointment made from oil of mustard and a few home simples! Musterole searches in under the skin down to the heart of the congestion. There it generates a peculiar congestion-dispersing heat. Yet this heat will not blister. On the contrary you feel a relieving sense of delightful coolness. Rub Musterole over the spot. And you get relief while you use it; for Musterole results usually follow immediately.

On no account fail to have a jar of Musterole handy. For coughs and colds and even the congestions of rheumatism or lumbago Musterole is wonderful. Many doctors and nurses recommend Musterole.

30c and 60c jars—\$2.50 hospital size. The Musterole Co., Cleveland, Ohio
BETTER THAN A MUSTARD PLASTER

MUSTEROLE
 WILL NOT BLISTER
 SEE US AT YOUR



10 Cents a Day Pays for This Symphonola

Place all records, Victor, Columbia, Edison, Pathé, Little Wonder, Emerson, John & Sons, etc., after 30 days trial. Complete return at our expense if it fails to make good. Ask today for the FREE

Beautifully illustrated Symphonola Book FREE. Shows how and other Symphonola styles sold on easy payments.

Symphonola Records—Get one of the latest new, latest new records. Possible to secure popular, clear sounding. List send for records. Possible to secure popular, clear sounding. List send for records.

Larkin Co. Desk SP5M 420. Buffalo, N.Y.

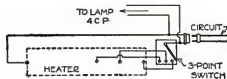
Over 100,000 in Use
 Ready sold through
 recommended
 For Personal Bank or
 General Office
 Buy through your dealer.
 Wholesale 10-day Trial Offer
 P. E. Gardner, Jr., & W. C. Co.
 140 Duane St., New York
 Canadian Agency

Golden Gem
 Adding Machine
 6666666
 2

Agents wanted

venience and can be turned on and off at will as desired.

Set the tray of solution in the opening adapted to its size and turn on the current at the plug. Then throw the switch on the first point and let the wire warm up. If not hot enough, throw the switch to the second point and to the third if found



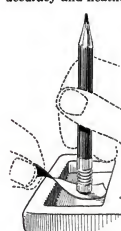
The wiring diagram shows how each wire is connected clearly and you should have no trouble in connecting each one to its designated point

necessary. The temperature can be easily regulated by these three points of contact as the different lengths of wire through which the current flows will generate different degrees of heat.

The solution will gradually take on the temperature generated by the heater which can be watched by the thermometer. The average temperature of solutions should be around 65 to 70 degrees; not over.—L. B. ROBBINS.

How to Use Emery Cloth in Inaccessible Places

ONE of the most aggravating jobs is the finishing of narrow depressions in castings of woodwork, where accuracy and neatness are required.



The sandpaper, under pressure of the pencil, smooths out uneven surfaces and corners

The difficulties ordinarily encountered in such work, however, are easily overcome by using the very simple method shown in the illustration.

This merely consists of gripping the emery cloth or sandpaper with the rubber-tipped end of an ordinary lead pencil and so working the abrasive.

The most convenient way is to tear off a narrow strip of the abrasive and to feed it under the pencil as a portion is worn.

The friction of the rubber against the free side of the cloth is so much greater than the friction between the abrasive and the wood or metal that the latter can be worked easily without slipping. The pencil permits a convenient handhold, and on account of the concentration of pressure on a small area the job is done quickly and thoroughly.—HENRY SIMON.



Knowing how Wins on Pay Day
KNOWING how is the thing that puts the big pay in the pay-envelope. It's the thing that lifts men out of a poor-paying job into a man's size job with a man's size pay. The man with the 'know how' under his hat always wins out. No matter what kind of work you are doing, or what you expect to do—you can learn more about that work and get more money for doing it. You don't have to go to school. Neither do you take any special training. One of these home study courses in book form will give you all the 'know how' you need.

Some of the world's greatest experts prepared these books just to help ambitious men get ahead. They are written in plain, good old U. S. language that anyone can understand. No puzzling technical terms. Everything is explained. Thousands of pictures, plans, blueprints, diagrams, etc., in each set. Over 100,000 sets have been sold. Pick out a set in line with your ambition and send the FREE TRIAL coupon that brings the books without your sending any money in advance.

Pay-Raising Books

Select from This List for FREE USE in Your Own Home

Automobile Engineering, 8 vol., 2160 pages, 2100 pictures. Was \$20.00. Now \$21.80	
Carpentry and Contracting, 5 volumes, 2138 pages, 1000 pictures. Was \$25.00. Now \$26.80	19.80
Civil Engineering, 9 vol., 3000 pages, 3000 pictures. Was \$45.00. Now \$46.80	29.80
Fire Prevention and Insurance, 4 vol., 1500 pages, 600 pictures. Was \$20.00. Now \$21.80	15.80
Electrical Engineering, 8 vol., 3000 pages, 3000 pictures. Was \$40.00. Now \$41.80	29.80
Machine Shop Practice, 6 vol., 2400 pages, 2400 pictures. Was \$30.00. Now \$31.80	19.80
Steam and Gas Engineering, 7 vol., 3500 pages, 3500 pictures. Was \$50.00. Now \$51.80	21.80
Law and Practice (with reading course), 15 vol., 6000 pages, illustrated. Was \$75.00. Now \$76.80	44.80
Telephony and Telegraphy, 4 vol., 1725 pages, 2000 pictures. Was \$20.00. Now \$21.80	14.80
Sanitation, Heating and Ventilation, 4 vol., 1450 pages, 1400 pictures. Was \$20.00. Now \$21.80	14.80
Drawing, 4 vol., 1578 pages, 1000 pictures, blueprints, etc. Was \$20.00. Now \$21.80	14.80
Accountancy and Business Management, 7 vol., 3000 pages, 2000 pictures. Was \$35.00. Now \$36.80	24.80

SPECIAL With each set of these books goes a one-year membership in our society. This entitles you to consult our engineers and experts on any subject connected with your work FREE. This membership usually sells for \$12.



This picture shows the automobile Engineering Books, 6 volumes closed and 1 open. Bindings will last a lifetime.

FREE Examination

Don't send one penny. Just fill out the coupon and mail it. This will bring any set you select (the whole set, not a sample) by express collect. The books will be yours to use as you please for an entire week. You be the judge and decide whether or not they will do for you what they have done for thousands of other men. If you don't think they will help you, send them back at our expense and you won't owe us anything.

50 Cents a Week! Pay only \$2.80 within one week if you keep the books and send us \$2 each month (for Law, \$3) until the special reduced price is paid. This amounts to about 7c a day. Mail the coupon NOW. You'll be mighty glad you did when pay day comes 'round.

American Technical Society, Dept. X-204, Chicago

American Technical Society, Dept. X-204, Chicago, U.S.A.

Please send me set of.....
for 7 DAYS' examination, shipping charges collect. I will examine the books thoroughly and, if satisfied, will send \$2.80 within 7 days and \$2.00 each month (Law \$3.00) until I have paid the special price of \$..... If I decide not to keep the books, I will return them within one week, at your expense.

Name.....

Address.....

Reference..... Please fill out all lines.

Make \$2,500 to \$4,000 a Year in

HAYWOOD'S TIRE SURGERY

5,000 More Miles To Old Tires

Stations Needed Everywhere

You know what 4,000 to 5,000 additional tire mileage means to motorists. Haywood's Tire Surgery is a new tire repair method that gives new life and thousands of miles of additional service to tires which before would be thrown in the junk pile. Think of what this means, man, as a money making opportunity. Think of the business that is going begging to pay you big money if you're ready to act.

HAYWOOD'S TIRE SURGERY

Is a **Wonderful Business**

Easy to Learn—No Experience Necessary

Uncounted millions of tires are cut, torn, gashed and bruised, broken down, worn out, yet with the Haywood method of tire surgery all these tires, no matter how far gone, can be put back into service. Every town, every hamlet, every city needs Haywood Tire Surgeons, and it's that we are offering you—a business of your own—a business that is already making hundreds of men rich and so will make you.

YOU CAN LEARN IN A WEEK walk right into \$2500 to \$4000 a year—be independent in business for yourself. Let us send you all the facts.

Mail Coupon—Get My Free Book

Just put your name and address on the coupon below, send it to me by return mail, and I'll send you without obligation full particulars of this money making opportunity. My Free Book explains everything. Tells how to start business with very little money. You can easily and quickly learn all about tires and my method of Tire Surgery. It will tell you how to handle every detail of the business. In fact, how to succeed and make money. Don't wait. Write me today. This is a stamp or post card will prove the best investment you ever made.

HAYWOOD TIRE & EQUIPMENT COMPANY
625 CAPITAL AVENUE INDIANAPOLIS, INDIANA

Mail To-day For All Facts

M. HAYWOOD, President
HAYWOOD TIRE & EQUIPMENT COMPANY
625 Capital Avenue, Indianapolis, Indiana

Dear Sir—Send me quick, without obligation, full particulars of Tire Surgery.

Name _____
Address _____

SIMPLE WIRELESS TELEPHONES AND HOW TO MAKE THEM. An essential book on the principles, construction and use of an system of wireless telephony. Illustrated. Price, postpaid, 25 cents.

POPULAR SCIENCE MONTHLY New York
225 West 39th Street

225 West 39th Street New York

"Lighting Fixtures"

Ready to hang.
Direct from manufacturers.
Completely wired including glass-ware.

Send for new No. 18 catalogue.
ERIC FIXTURE SUPPLY CO.
Desk A, Erie, Pa.

NO-LEAK-O ONE PIECE

On market 5 years.
1,000,000 a month.
Beware imitations.
"NO-LEAK-O"

Patented Trade Mark Reg.
NO-LEAK-O Piston Ring Co., Baltimore, Md.

NO-LEAK-O Piston Ring Co., Baltimore, Md.

NO-LEAK-O Piston Ring Co., Baltimore, Md.

NO-LEAK-O Piston Ring Co., Baltimore, Md.

NO-LEAK-O Piston Ring Co., Baltimore, Md.

NO-LEAK-O Piston Ring Co., Baltimore, Md.

NO-LEAK-O Piston Ring Co., Baltimore, Md.

NO-LEAK-O Piston Ring Co., Baltimore, Md.

NO-LEAK-O Piston Ring Co., Baltimore, Md.

NO-LEAK-O Piston Ring Co., Baltimore, Md.

Earns \$800 Month

This is
E. T. Buchmann

He is a Tire Surgeon at Chicago. He says: "I am earning \$800.00 per month, and confining myself solely to re-building tires of tires by Haywood Method."

\$5,500.00 Home Paid For

John W. Blair, Toledo, Ohio, says: "When I started three years ago, I had just \$50.00 left after paying for my outfit. I now have a \$5,500.00 home paid for, \$1,000.00 in one bank, and deposits in several others."

HAYWOOD TIRE & EQUIPMENT COMPANY

INDIANAPOLIS, INDIANA

INDIANAPOLIS, INDIANA

INDIANAPOLIS, INDIANA

INDIANAPOLIS, INDIANA

INDIANAPOLIS, INDIANA

INDIANAPOLIS, INDIANA

INDIANAPOLIS, INDIANA

INDIANAPOLIS, INDIANA

INDIANAPOLIS, INDIANA

INDIANAPOLIS, INDIANA

INDIANAPOLIS, INDIANA

INDIANAPOLIS, INDIANA

INDIANAPOLIS, INDIANA

INDIANAPOLIS, INDIANA

INDIANAPOLIS, INDIANA

INDIANAPOLIS, INDIANA

INDIANAPOLIS, INDIANA

INDIANAPOLIS, INDIANA

INDIANAPOLIS, INDIANA

INDIANAPOLIS, INDIANA

INDIANAPOLIS, INDIANA

INDIANAPOLIS, INDIANA

INDIANAPOLIS, INDIANA

INDIANAPOLIS, INDIANA

INDIANAPOLIS, INDIANA

INDIANAPOLIS, INDIANA

INDIANAPOLIS, INDIANA

INDIANAPOLIS, INDIANA

INDIANAPOLIS, INDIANA

INDIANAPOLIS, INDIANA

INDIANAPOLIS, INDIANA

INDIANAPOLIS, INDIANA

INDIANAPOLIS, INDIANA

INDIANAPOLIS, INDIANA

INDIANAPOLIS, INDIANA

INDIANAPOLIS, INDIANA

INDIANAPOLIS, INDIANA

INDIANAPOLIS, INDIANA

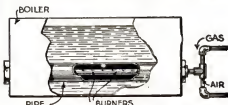
Are You Interested in Boiled Automobiles?

"NOT boiled—boiled!" exclaimed the repair-shop manager.

"Oh, I thought you said boiled," replied the visitor. "Even so, I think they would make tough eating."

The manager gave a sigh of despair, and then went on to explain the merits of the new boiler, into which parts of an automobile are thrown for the purpose of removing the grease. The illustration gives a general idea of the construction.

A 4-in. pipe leads into the boiler, and is surrounded with the water.



An easily constructed hot-water bath for removing grease from automobile parts

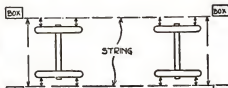
Inside this pipe is a gas-burner of any suitable make, the flame from which plays against the interior of the piping and raises the water to the boiling temperature. A good washing powder is sometimes added to the water and aids in the cleansing.

Parts of an automobile can be repaired more effectively when clean, and no better method for the cleaning is found than simply immersing in the hot-water bath. A few minutes' boiling removes all particles of grease, and leaves a clean surface that can be soldered or otherwise mended. Not only the surfaces but the interiors of parts are thoroughly cleansed by this boiling process.—H. C. RIDGELEY.

Assuring the Motorist of Properly Aligned Wheels

LINING up the wheels of an automobile is a problem that many motorists do not attempt because they do not know how; but the following method is easy and accurate in every case.

Set the car in an open space on an absolutely flat floor. Place two boxes on the floor, one about two feet from the rear right wheel. Now stretch a



Automobile wheels out of alignment give short tire life. Keep them properly aligned by this simple method

string between the two boxes, being careful to keep the string at an even distance from the floor. Measure from this string to the front and rear parts

HOW TO MAKE WIRELESS INSTRUMENTS. A little book that fully describes the construction of spark wireless instruments and apparatus. Just the thing for the amateur. Illustrated. Price, postpaid, 25 cents.

POPULAR SCIENCE MONTHLY New York
225 West 39th Street

225 West 39th Street New York

AMAZING PROFITS

In Hares and Cavies
We pay \$7.00 to \$13.50 a pair for Hares and \$1.50 to \$2.00 a pair for Cavies, and Express Charges. We furnish largest and finest guaranteed high grade stock and buy all you raise. Free Illustrated Booklet and Contract.

UNITED FUR & FUR ASSOCIATION
329 W. 45th St., Dept. 1, New York

You Can Save \$50.00

By recovering your old auto top 1 case yourself. We make those recoveries to fit all makes and models of cars. Any person that can drive a car can put it on. We furnish instructions. Roof and quarters sewed together with rare canvas, buttons, vents and latches. All complete. Give us the name, year and model number of your car and we will send you our catalogue with samples and quote you exact price.

\$6.84 and up
Partial Post Paid

LIBERTY TOP & TIRE CO., Dept. EA, Cincinnati, O.

ARMS OF STEEL

The Barker Power Grip will double and treble the strength in your fingers, hands, wrists and forearms in a remarkably short time. The Power Grip is of special value to and highly recommended by Doctors of Dental Surgery, Plasterers, Telegraph Operators and Typewriters. A strong grip is acquired more than any other form of strength. In fact, it has saved many a person's life, in case of emergency. Those who suffer from cold hands or perspiring hands will obtain great benefits by using the Grip a few minutes a day. The price of the Barker Power Grip is **\$1.00 postpaid**

Prof. A. BARKER, D. C., Studio 6500, 127 W. 42nd St., N. Y.

of the right front and rear tires. If the distances are not equal, shift the boxes or the steering wheel until they are exactly so. The string will then be exactly parallel to the line of the wheels on that side.

Then, with a second pair of boxes and a string, do the same thing on the left side, thereby obtaining another line. When this is accomplished, measure across from one line to the other, making sure that these two are equal distances from the wheels. Do the same at the rear. If these two measurements agree exactly, the wheels are in alignment.

How a Drill Is Cut to Bore Hard Rock

SURVEYORS in mines use a permanent station mark a "spad" driven in the roof of the mine. This



This drill will bore through the hardest stone

is a flat piece of metal driven into a wooden plug that has previously been driven into a hole bored in the solid rock of the miner's roof. They then hang a plumb-bob from the "spad" as a sight-line.

The rock composition of the roof may vary from soft shale through several degrees of hardness to what is called sand-rock, which is the hardest rock to drill. Perched on a ladder with one foot and hanging on with the other, it is no easy job to take a regular hand drill and hammer upon it.

The writer tried a brace and regular twist drill, but even that wouldn't bite. Several different ways of sharpening were tried out, and finally the way shown in the illustration was evolved. A high-speed twist drill sharpened in this way will drill almost any stone. By cutting its center away the same effect is produced as with the diamond drill used for removing test plugs.—S. B. ROYAL.

A Very Useful Drawing-Table Extension

AN extension to a drawing-table which is as simple as it is useful, and which, when not needed to increase the capacity of the table, can be instantly converted into a convenient tray for holding accessories, is shown in the illustration on page 128.

The extension consists of a 12-in. board of a thickness corresponding to that of the table, and provided with two narrow cleats about two feet long. Each cleat has through its free portion a $\frac{3}{8}$ -in. hole at a point close to the board to permit the passage of a $\frac{1}{4}$ -in. stud, which is tightly screwed into the

The World of Industry Needs DRAFTSMEN



You Can Learn Quickly By Our Practical Method

If you are a person of even average ability, you can master the profitable profession in five to six months. You can leave home through our famous "Home Study Course." You can in a short time become a first class draftsman. The reason of the fact that our training is most thorough and practical and because you will be personally instructed and coached by the President of the school, Ray C. Cliffe, whose long experience as a draftsman and a teacher especially qualifies him to give you the kind of training you need. We teach you to work from actual models just as you would in a drafting room, instead of merely copying from books.

Draftsmen Get \$35.00 to \$100.00 a Week

Every mechanical idea must be drawn out by the draftsman before it can become a reality. On account of the importance of his work, he is therefore paid a good salary and is always in fine for advancement. Drafting is not only one of the best paying professions, but in the stepping stone to higher opportunities. Many men, receiving up to \$40.00 a year, and over in technical positions, owe their success to their knowledge of Drafting as the starting point. General construction companies, manufacturers of machinery, locomotives, and automobiles, designers of tools and special equipment, makers of airplanes, large engineering companies, in fact, all branches of industry need DRAFTSMEN today in greater numbers and at better salaries than ever before.

"Columbia" Graduates are the Kind of Draftsmen that are Needed

The properly trained Draftsman, such as those graduated by the COLUMBIA SCHOOL OF DRAFTING, are the ones who get the preferred positions and best salaries, and are the ones who are most greatly in demand. The success of our students demonstrates this fact. Columbia graduates are filling important positions in big concerns throughout the country. We would like to send you a book of testimonials from many of our hundreds of students and graduates who present highly paid positions as Draftsmen as the result of their practical training with us. A few of these letters are here reprinted.

No Previous Training Required

As our students are given practical Drafting work from the beginning of our course, they grasp the subject quickly, so that no previous training or drafting experience of any kind is required to take up this work with us. You do not need a high school education to learn Professional Drafting as taught by this school and the training we give you is all that is needed to secure a position as Draftsman. Fred F. Johnson's letter.

Drawing Outfit Furnished Students

We furnish, without extra charge, an individual drawing outfit to all our students for use throughout the course. This becomes your property as soon as the course has been paid for.

MAIL THIS COUPON TODAY

Your future success depends upon what you do TO-DAY. If you are interested in learning this interesting and big paying profession, send the following coupon WITHOUT DELAY for our Free catalog of particulars. COLUMBIA SCHOOL OF DRAFTING, Dept. 1097, 14th & T Streets, N.W., Washington, D. C.

COLUMBIA SCHOOL OF DRAFTING

Dept. 1097, 14th & T Streets, N.W., Washington, D. C.

Without obligation to me, please send me FREE your illustrated book of particulars, testimonials from students, rates and liberal terms.

Name

Street and No.

City State



Complete Musical Outfits On Trial

YOU may have your choice of instruments and a complete musical outfit for a week's free trial in your own home. Outfit includes ever, music books, all accessories, instruction book, etc. at factory prices. A tremendous saving.

Convenient Monthly Payments

After trial return outfit at our expense if you wish. If you decide to buy you may pay the low direct price in small monthly amounts. Warranted for 99 years has finest highest quality.

Send this Coupon

We'll send you free and without obligation a Wurlitzer New-type illustrated catalog. Mail the coupon. The Rudolph Wurlitzer Co., Dept. 1274, 2140 N. Lincoln Ave., Chicago, Ill.

The Rudolph Wurlitzer Co., 117 E. 4th St., Cincinnati, Ohio 222 S. Wabash Ave., Chicago, Ill. Send free price 100-page catalog with full details of complete musical world on easy terms.

WURLITZER

Name
Address
Telephone



Earning \$9.99 in Two Hours
with an Auto-Wheel Coaster
and Some Old Boxes

A SAN FRANCISCO BOY, "J. P. B." (name on request) turned the trick. He says any Auto-wheel Owner can do the same thing whenever there is a parade or a big celebration in town. Just before one of the big Frisco parades, this lad collected up a lot of empty wooden boxes. Then, when the spectators began to line the sidewalks, to see the parade, he loaded his Auto-Wheel with all the boxes it would hold, and started through the crowd. And, as he said, the people almost fought one another to buy the boxes at 25 cents each—to sit on. He handled about \$5 worth of his "stock" at a time, for he found he could fit the boxes one inside the other. The Auto-Wheel Coaster can carry 100 pounds with ease, so he had no need to fear overloading.

Do You Know the Story of Auto-Wheel Wagons?

The Auto-Wheel Coaster and Auto-Wheel Convertible Roadster have boy friends all over the country, and in Canada. The Coaster is an all-around wagon for hauling and coasting. The Convertible Roadster is two wagons in one. One minute it is a box wagon. Towing the sides up, and you have a long, lean racer, built to suit a boy's own ideas. Auto-Wheels are sturdy wagons, easy to steer, fast and smooth running, good looking. Roller bearings give real speed, and there's a dependable brake for slowing down at corners.



Auto-Wheel Magazine Free

Every boy should send for this interesting publication. Get on the mailing list. Send us the names of three Coaster dealers, telling which one handles the Auto-Wheel. We send the magazine—also the Auto-Wheel Booklet—free.



Organize An Auto-Wheel Coaster Club

Write us for our plan of giving Frisco caps to members of these clubs, and a special cap to the captain.

THE BUFFALO SLED COMPANY
157 Schenck Street, N. Tonawanda, N. Y.
In Canada: Preston, Ont.

Women Shoot With Certain AIM

When they equip their guns with the Maxim Silencer it eliminates the report entirely. No firing, no recoil, no "muzzles." Makes target practice and mail gun shooting a fascinating experience for the whole family.

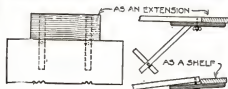
MAXIM SILENCER

Price, \$25.00. \$5.00. You attach it to rifle yourself. Ask your dealer for free book of astonishing experiences of Maxim Silencer users.

Maxim Silencer Co.
61 Montross Ave., Herndon, Va.

table-top from the bottom. A wing-nut on each stud permits the extension to be quickly tightened or loosened.

Such an extension is exceedingly useful where the capacity of a drawing-table must be at times increased, as in perspective drawing or for exceptionally large work. If desired, it can be instantly demounted, but this will hardly ever be found desirable. Instead, by merely unscrewing the wing-



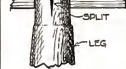
This extension to the drawing-table is a great help to the draftsman in limited quarters

nuts a few turns, the extension may be converted into a wide and convenient shelf for holding drawing instruments, pencils, pens, ink erasers, and other objects where they are both out of the way and cannot roll on the work. There is no obstruction in the path of the T-square, since even if it is longer than the width of the table, it will pass over the objects on the tray.

On account of its construction, the extension when in this position is securely in place, the weight of the board itself holding the free ends of the cleats firmly.—HENRY SIMON.

Making That Rickety Chair Steady Again

THE chair with one or more legs that are everlastingly coming out is a nuisance and should not be tolerated. It is a common source of annoyance now that chairs are frequently made of unseasoned wood. Here is one way to repair the offending leg.



An easy and efficient way to mend a chair leg that falls out of place

into which the leg fits. Remove all glue, if there is any, from the chair-bottom hole.

Next, get a good piece of walnut or some other hard wood, and cut out a wedge $\frac{1}{2}$ in. long and as thick as the looseness of the offending leg requires. Insert this wedge tightly into the split. If the leg is very loose, daub a little glue about the leg end.

With the wedge inserted in the split, place the leg end in the bottom hole, and with a hammer drive it back to its original position. As the driving process is continued, the wedge enters into the leg end. The result is a leg end which fills its hole tightly and never comes out.—JOHN T. BARTLETT.

Attach This Motor to Your Boat



New pleasures are open to the man who attaches a Lockwood-Ash Row Boat Engine to his row boat.

It saves those long, hot, back-breaking pulls to the fishing or picnic grounds or the camp.

It is simple, economical and practical and takes but a few minutes to install.

Ask for our booklet and learn about the 30-day trial plan.

Lockwood-Ash Motor

Company

2913 Jackson Street
Jackson, Mich.

(69)



Build Your Own PHONOGRAPH

It's Easy With Our Help

Interesting work—many materials—given you a fine machine exactly to suit your ideas—easy or half. Plans say round. Our customers always succeed because our system is simple. No special skill necessary. We furnish complete, plain plans and diagrams—motors, tone arms, case material, everything required and full instructions. Charles F. Monroe, Washington, says:—I received the outfit and am well pleased. Build one machine for my son and an order for one for \$11.25 I have none done. It's a wonderful tone.

Make Money Building Phonographs

And for Your Own Free Blue Print Offer.

We have started many others. We can start you.

For part, new work. N. J. Adams. A. Schmitt, says:—

"Just sold my phonograph, which I built from your plans and parts at nearly \$100 per set."

We are the old reliable house organizations of the house building idea.

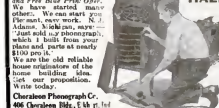
Get our proposition. Write today.

Cherokee Phonograph Co.

406 Cherokee Bldg., E. 8th St., Ind.

Get Our FREE Blue Print OFFER

SAVE OVER HALF



Cherokee Phonograph Co.

406 Cherokee Bldg., E. 8th St., Ind.

KENNEBEC CANOES

Safest to Use

The "Tumble Home" of the Kennebec makes it so—the fact is illustrated here—the dotted line being The Tumble Home of the ordinary canoe—the black or outside line that of the Kennebec.

Fullset particulars with illustrations of all our models given in our 1929 book, sent postpaid.

KENNEBEC BOAT AND CANOE CO.

29 R. Square, Waterville, Maine.

SAVE 25% to 60%

on a highly used GRAFLEX-KODAKS

Camera and lenses of every description. Repair, new, like new. Write now for Free Bargain Book and Catalog.

Monthly save and own camera and equipment. All goods sold in 10 days. Free trial. Money back if not satisfied. You take on pleasure and profit in the photography business over 10 years.

Write now. CENTRAL CAMERA CO.

Dept. 64, 124 Wabash Ave., CHICAGO

\$5000 IN SCHOLARSHIPS

Entries Close April 1, 1930

If you want to compete for one of our Popular Science Monthly \$500 Scholarships ask your school principal to send in your name on or before April 1, 1930. Full conditions given in the February issue of the Popular Science Monthly.

Scholarship Committee, Popular Science Monthly, 225 W. 39th St., New York

WANTED—A Representative in every factory in the United States. Popular Science Monthly, 225 West 39th Street, New York.



Electricity Learn at Home

There is a wonderful opportunity right now for young men who like electricity. If you are ambitious and will train yourself in spare time you can step into a good position and get experience that will give you a real start toward success in life. Good salaries are offered with rapid promotion.

For 28 years the International Correspondence Schools have been training young men for success in electricity and over 200 other subjects. They will help you prepare right at home for a position in the line of electrical work you like best—or in any other work that appeals to you. Thousands of men, through I. C. S. training, have stepped into fine jobs, but never were opportunities so great as now.

Let the I. C. S. help you. Choose the work you like best in the coupon below, then mark and mail it today. This doesn't obligate you in the least, and it will bring you information that may start you on a successful career. This is your chance. Don't let it slip by. Mark and mail this coupon *now*.

INTERNATIONAL CORRESPONDENCE SCHOOLS BOX 7673, SCRANTON, PA.

Explain, without obligating me, how I can qualify for the following, or in the subject, before which I mark X.

☐ ELECTRICAL ENGINEER	☐ OFFICIAL ENGINEER
☐ Electrician	☐ SALESMANSHIP
☐ Electric Wiring	☐ ADVERTISING MAN
☐ Electric Lighting	☐ Window Trimmer
☐ Electric Car Running	☐ Show Card Writer
☐ Heavy Electric Traction	☐ Outdoor Sign Painter
☐ Electrical Draftsman	☐ RAILROAD
☐ Electric Machine Designer	☐ ILLUSTRATOR
☐ Telegraph Expert	☐ DESIGNER
☐ Practical Telegraphy	☐ BUSINESS MANAGEMENT
☐ MECHANICAL ENGINEER	☐ Private Secretary
☐ Mechanical Draftsman	☐ BOOKKEEPER
☐ Ship Draftsman	☐ Bookkeeper and Typist
☐ Machine Shop Practice	☐ Cert. Pub. Accountant
☐ Toolmaker	☐ Traffic Management
☐ Gas Engineer	☐ Commercial Law
☐ CIVIL ENGINEER	☐ GOOD ENGLISH
☐ Surveying and Mapping	☐ STATIONARY ENGINEER
☐ FIRE PROTECTORS	☐ CIVIL SERVICE
☐ ARCHITECT	☐ Railway Mail Clerk
☐ Architectural Draftsman	☐ Electrician
☐ PLUMBING AND HEATING	☐ AGRICULTURE
☐ Sheet Metal Worker	☐ Penmanship
☐ Navigator	☐ Spanish
	☐ French
	☐ Italian

Name _____
 Present Occupation _____
 Street and No. _____
 City _____ State _____

Immortalizing Baby's First Shoes

By Samuel Wein

A MOTHER who couldn't bear to throw away her baby's first shoes called upon a number of electroplaters to see whether she could have a metallic coat applied to the shoes. Her idea was to preserve them and at the same time make them ornamental.

Leather is a non-conductor of electricity and it was for this reason that electroplaters thought the work impossible. However, one enterprising young man accepted the commission and successfully carried it out. A new field for the electroplater was thus opened, and today there are a number of large concerns that specialize in this particular kind of work.

There are five successive steps in plating the shoes: drying; water- and acid-proofing the shoes; making the shoes conductive to the current; copper-plating; finishing, as buffing or polishing, and lacquering.

The drying can be done either in the air or in a chamber of hot air.

The first operation is to make the shoes absolutely water- and acid-proof. Unless this is done, the solutions will penetrate and destroy the leather, thus spoiling the whole operation. First dip the shoes for about thirty minutes in a hot composition made up of 8 oz. beeswax, 2 lbs. paraffin and 5 oz. rosin.

Upon removing the shoes, you will find that they are coated with a thin film. This is allowed to cool.

The next operation is to give the shoes a thin coat of shellac and allow them to dry in the air for about three hours. When thoroughly dry give them two coats of the following mixture: 3 oz. copper-plating bronze powder, $\frac{1}{2}$ pint lacquer and $\frac{1}{2}$ pint amyl acetate.

After the shoes have been carefully and thoroughly coated place them again in the air to dry. This usually takes from five to six hours. They are then ready to be copper-plated. Before the shoes go into the plating

solution, great care must be exercised not to handle them roughly, for even finger-prints prevent the correct deposition of metals.

Now secure a $2\frac{1}{2}$ -gallon porcelain crock or glass jar, and pour in the following solution: 2 lbs. copper sulphate, 2 gals. water, and 6 oz. sulphuric acid.

Upon this crock place two brass or copper rods and connect them with the source of current. From one of the rods suspend one shoe in the solution, and on the other rod hang a piece of sheet copper about 6 in. square and $\frac{1}{8}$ in. thick. The rod that holds the shoe acts as the cathode and the piece of sheet copper as the anode.

The source of current employed may

be from batteries, and their amperage must be in the neighborhood of six or eight to the square foot of surface to be plated. The potential should be about one volt. Leave the shoe in this solution for about twenty-four hours, when a coat of $\frac{1}{64}$ in. copper will be smoothly deposited upon them. Allow it to dry and then buff or polish it.

Some people prefer a different metal from copper. Brass is very attractive. Here is the formula for brass used by the writer: 6 oz. copper cyanide; 9 oz. zinc cyanide; 3 oz. hypo; 3 oz. sodium phosphate; 1 gal. water.

Brass-plating is done on the copper and requires about one hour.

When the plating is finished and polished, it may be lacquered all over, to prevent the metal from tarnishing. The shoes may be polished from time to time with an ordinary metal polish.



Here are the completed shoes encased forever in a thin film of brilliant metal



Every mother cherishes baby's first shoes. Here's a way to preserve them in metal



You Can Do It—

You Can Play Those Jazzy Song Hits Without Knowing One Note From the Other

No—not by the **do-re-mi** method. Not by the old tiresome method of notes and scales and arpeggios. Not at the great expense of years of fruitless study.

There's a new way—the simplest, quickest, most interesting method of learning to play the piano that you ever heard of. It makes it easy to **play a song by ear after hearing it a couple of times.**

You Can Learn to Play in 3 Months

You can learn at home, during your spare time. It will not require long hours of study and practising. It is not expensive.

Our amazing new course, developed just a year ago, has taught hundreds of men and women how easy Jazz music is to play.

Many of these could not play at all when they began our course. To-day they can reel off the latest, snappiest jazz music by ear.

It's the New Method That Makes It Possible

For instance, when you receive the course by mail, you'll be surprised to find how easy it is to understand. It just comes natural to you to pick out pieces on the piano as we teach you.

And you make progress from the very start. The lessons will show you some real little tricks of playing. Our students, after finishing the full course are able to play anything they hear. All by ear.

The person who can play jazz to-day is popular in any crowd. His talent gives life to any party.

And, if he develops that talent as we teach him to develop it, the opportunities for profit are splendid. The Stage is open to those who can play the piano as the Niagara method teaches.

It may be hard to believe. You may doubt, as others have, our ability to teach you by mail (in one-tenth the time and at one-tenth of the usual cost) what most music teachers cannot teach you by personal instruction.

But if you'll let us send you our literature, you'll find some proofs that will surprise you. Just write for our **FREE Booklet** and see.

NIAGARA SCHOOL OF MUSIC

Dept. A-3

Niagara Falls, N. Y.



COUPON

NIAGARA SCHOOL OF MUSIC,
Dept. A-3, Niagara Falls, N. Y.

Please send me your **FREE Booklet** describing your method of playing by ear.

Name.....

Address..... City.....

For the Radio Experimenter

Electron Relays as Amplifiers and Oscillators

By H. J. van der Bijl, M. A., Ph. D.

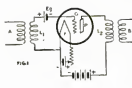


Fig. 1. A typical hook-up for using a vacuum tube as an amplifier

AS an amplifier an electron relay supplies a great need. As an oscillation generator it is no less valuable. Only ten years ago the problem of the production of high-frequency continuous oscillations was one of the most important and difficult problems in the radio art. This was specially true of oscillations of moderate power produced at high efficiency.

There was then in existence the Poulsen arc; afterward came the Goltschmidt and Alexanderson generators. These devices are used commercially for the transmission of radio and telegraphic messages, and have been successful over long distances. Large amounts of power are needed, however. When compared with the thermionic vacuum tube, we find that the arcs and generators lack certain advantages that the vacuum tube possesses and that place the tube in a different class.

It is true that at the present time a single vacuum tube does not handle very large amounts of power. This does not, of course, mean that it will always be limited to short-distance transmission. As a matter of fact, it will be recalled that in 1915 the American Telephone and Telegraph Company and Western Electric Company transmitted speech by radio from Arlington to Paris and Honolulu, a

distance in the latter case of five thousand miles, and this was done with the thermionic vacuum tube. Once experiment has indicated the



A small Poulsen arc generator

way, commercial applications are sure to follow. The use of the vacuum tube as an oscillation generator for the transmission of speech over several hundred miles is already a commercial possibility.

Whatever the amount of power that the tube is made to produce in the form of alternating current, the principle of operation is the same. One advantage of this type of oscillation generator is high efficiency. Another is that it can be made to produce oscillations varying over a considerable range of frequency. This varying can be adjusted almost instantly, and the power output controlled with the expenditure of hardly any energy.

Oscillations from Direct Current

In order to understand how the tube can be made to produce oscillations from direct current, it is necessary first to look into its service as an amplifier. It is the amplifying property of the tube that makes it a valuable device. The electron current flowing through the tube from filament to plate can be controlled by varying the potential on the grid, and to vary this potential only a very small amount of energy is necessary, although the variation of energy in the output or plate circuit can be very large. This is its amplifying property and it is due to the grid.

Suppose the tube be inserted in a circuit such as that shown in Fig. 1. The circuit FGL₁ forms the input circuit and FL₂P the output circuit. The coil L₁ of the input transformer, and is preferably wound to have a very high impedance. The transformer in the output circuit is wound to have an impedance equal to the resistance of the tube.

Currents coming in from the line A are amplified by the tube. By this

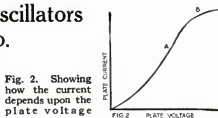


Fig. 2. Showing how the current depends upon the plate voltage

we mean that if the impedance of the line A is equal to the impedance of the line B, we find that the current in B is greater than that in A. This is how the tube is made to amplify telephonic currents on long-distance lines.

To explain this a little more fully, let us consider the characteristic curves of the vacuum tube. The relation between the current in the output circuit FPL₂ and the potentials applied to the grid G and the plate P with respect to the negative end of the filament F is given by the equation

$$I = A(E_g + \mu E_p)^n$$

where

E_g is the potential difference between the filament and the plate.

E_p the potential difference between filament and grid.

Suppose that in this equation E_g be made equal to zero; that is, let the grid be connected directly to the negative end of the filament. Then the relation between the current I and potential E_p on the plate can be given by a curve like that shown in Fig. 2.

It will be noticed that, as the plate potential is increased, the current at first increases more and more rapidly, but finally becomes independent of any further increase in the plate voltage.

This maximum value to which the current rises depends on the temperature of the filament.

If the filament is raised to a higher temperature the current will increase until a higher maximum value is reached.

If, on the other hand, we give the plate potential a constant value, but vary the potential of the grid, we get the curve shown in Fig. 3. It will be seen that when the grid potential is zero the electron current flowing from filament to plate is not zero, but has a value given by OF. This is because the potential on the plate causes a field to act through the openings of the grid and so pull the electrons through the grid to the plate. If the potential of the grid now be made positive, the current to the plate increases as shown by the curve FG.

If, on the other hand, the potential

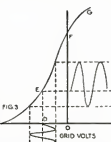
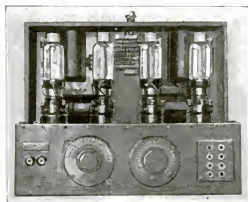


Fig. 3. How the plate circuit current at constant voltage is altered by changing the voltage applied to the grid circuit



A vacuum-tube amplifier set of German wartime manufacture, captured by the French

LEARN WIRELESS

By Mail - In Ten Weeks

Radio Telegraphy and Telephony

Mastered at Home by Marvelous New Method

Through our Famous Home Study Course and with the help of our wonderful Natrometer outfit you can quickly learn both Wireless Telegraphy and Telephony in a few short weeks in your spare time and at home—without inconvenience or loss of time from work. Students of this institute have finished the course and secured their official license after approximately only ten weeks' instructions.

First Grade License Guaranteed

Our course is so thorough and our method of instruction so practical that we are able to guarantee that, after successfully completing our course, you will be able to pass the examinations and secure a first-grade government operator's license.

Salaries Up to \$15,000 a Year

The pay of Wireless Operators, Radio Inspectors, Wireless Aids, Machinists, Electricians and Wireless Engineers varies from \$225 a month to start for operators to \$15,000 a year and salaries should advance steadily in line with the rapid developments in this profession. The demand for wireless operators and workers in all branches of wireless is enormous and positions are guaranteed to all graduates of this institute as soon as they secure their first grade government license.

Travel and See the World

or locate in one of the many Land Radio Offices now open. Radio provides a broad field of opportunity and activity. If you like to travel you can visit foreign countries—if life on the seas or lakes appeals to you there are positions in coastwise and lake shipping service—if you are best fitted for indoor work and prefer to be near your home there are the land radio stations, manufacturing plants and railroads—and for real adventure you have the aerial mail and commerce.

MAIL THIS COUPON TODAY

NATIONAL RADIO INSTITUTE.

Dept. 188, 14th and U Sts., N. W., Washington, D. C.

Send me your free book, "Wireless, the Opportunity of Today," telling me about the opportunity in Wireless, your Famous Home Study Course in Wireless Telegraphy and Telephony, your post-graduate course, the N. R. I. Radio Relay League and your special wireless instrument offer.

Name.....

Address.....

City..... State.....

This Fine Natrometer Set Furnished Every Student

of the National Radio Institute. It is a wonderful set designed and built especially for us and comes to you complete in neat carrying case. It embodies the same type of wireless instruments which are used by the United States Bureau of Navigation in testing applicants for first grade wireless operators license, with the addition of many improvements developed through our years of experience in this field. The Natrometer automatically sends you wireless messages just as you would receive them from a station thousands of miles away. We do not merely loan you the Natrometer. We give it to you. It becomes your personal property upon your completion of the course.

Special Privileges to National Radio Institute Students

Students of the National Radio Institute receive the following: Complete combination course in Wireless Telegraphy and Telephony—

Special post-graduate course at our large Washington school, if desired—

Five text books, one hand book, forty-six special lessons and eighteen personal examinations—

Membership in the N. R. I. Radio Relay League and handsome blue-and-gold membership pin presented immediately upon enrollment—

Large handsome diploma suitable for framing—

Complete automatic Natrometer outfit and carrying case—

Personal help in securing wireless position and endorsement of Institute officials.

Send For FREE BOOK

We have prepared a book telling all you want to know about wireless and the future it offers you, stating facts you are interested in are freely discussed. It tells how, during the past six years we have helped hundreds of ambitious men and women and how we will help you. Send the coupon to-day or write to the National Radio Institute—America's first and foremost—Est. 1914—Dept. 188,—14th and U Sts., N. W., Washington, D. C.

The National Radio Institute

Dept. 188, 14th and U Sts., N. W., Washington, D. C.

Big Pay

IN FASCINATING NEW
RAILROAD JOBS

Learn at home in spare time to fill a big-pay fascinating job as Signal Engineer. The demand is growing daily for men to install, supervise and maintain signal systems and other safety devices on railroads everywhere. Steady employment, good income right from the start.

\$2500 TO \$5000 A YEAR!

Qualify for one of these jobs! Study the money! Enjoy every minute of your work! Don't fail! For free information about this exciting opportunity, write for valuable **FREE BOOK** "Signal Engineering".

Write for Valuable **FREE BOOK** "Signal Engineering". Don't fail! Study the money! Enjoy every minute of your work! Don't fail! For free information about this exciting opportunity, write for valuable **FREE BOOK** "Signal Engineering".

SIGNAL ENGINEERING

Dept. 9204,
1924 Sunnyvale Ave.,
CHICAGO, ILL.

of the grid be made negative, the current to the plate decreases as shown by the curve FEC. At the point C the negative potential of the grid is sufficiently high to neutralize the effect of the positive potential on the plate. The positive potential on the plate

the grid does not become greater than DO, it will be seen that the grid never becomes positive with respect to the filament, so that the grid never takes any current, and therefore there is practically no expenditure of energy in the grid circuit. The power in the plate circuit is therefore varied without it being necessary to spend an appreciable amount of energy to do so.

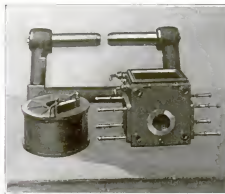
Explanation of Constants

The constant μ is known as the amplification constant of the tube. What it really means is that a change in the potential of the grid produces μ times as great a change in the plate current as an equal change in the plate potential. In other words, we can look upon a change, e , in the grid potential as being equivalent in effect to an electromotive force μe impressed in the plate circuit.

The tube can therefore be used as a voltage amplifier. If the impedance of the coil L_2 is very high compared to the resistance of the tube, a change e in the potential of the grid will establish a potential difference between the ends of L_2 equal to μe . If the impedance of the coil L is not so large, the voltage amplification produced will be less than μ . The extent to which it will be smaller depends on how large the impedance of L is compared to the resistance of the tube.

Suppose, for the present, that L is a pure non-inductive resistance equal to R , and let the resistance of the tube be R_p . Then the relation between the voltage amplification and the ratio R/R_p is given by the curve shown in Fig. 4. If L is not a pure resistance but an inductance, then this curve is somewhat different but has a similar shape.

Now μ the amplification constant, depends on the structure of the tube, and can be made to have almost any



Here are the principal parts of the Poulsen arc shown in another illustration

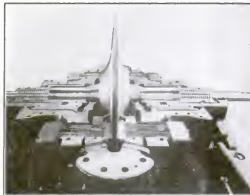
tends to pull the electrons away from the grid, while the negative potential on the grid tends to drive them back. When these two effects are equal the current through the tube is reduced to zero.

The exponent "n" in the equation is not a constant when we consider the whole range of the characteristic up to the bend at B in Fig. 2 or G in Fig. 3; but it can be put equal to a constant for shorter ranges of the characteristic, to a sufficiently high degree of accuracy for the purpose for which the tube may be used.

Thus if the tube is used as an amplifier (in which case we operate over the part of the characteristic EF or somewhat greater) we can put $n=2$. For lower values of current the exponent n generally becomes larger, and for higher currents it generally becomes somewhat smaller.

Referring again to the circuit diagram shown in Fig. 1, let the grid battery E_g have a value given by OD (Fig. 3); then the current through the tube is equal to DE, if the potential on the plate is that which gives a current OF when the grid potential is zero. Of course, if the plate potential now be made higher, the current to the plate increases, and we have a curve lying above the one shown in Fig. 3.

For the present, however, we shall consider only the curve CEEF. If now an alternating current flows through the circuit A (Fig. 1), alternating potentials will be applied to the grid through the input transformer. These potential variations will be superimposed upon the constant voltage of the grid battery E_g , so that the potential of the grid will oscillate around the point D in Fig. 3, and this alternately increases and decreases the current in the output or plate circuit of the tube. If the peak value of the alternating potential on



Cross-section and rotating inductor of an Alexanderson generator. These are the machines the Radio Corporation expects to use for long-distance radio

desired value. In most amplifier types of tubes μ has a value of about 5 or 6, but the tube can be designed to have a much larger value of the amplification constant. Voltage amplifiers are in use that have an amplification constant equal to 40. But they can be made to

FREE

course
Secret Service

MORE Finger Print Experts are needed. Men who are masters of this profession are scarce. The demand for Finger Print Experts is great. As a special inducement we will give you free of charge our new easy reading course in Secret Service Intelligence if you act at once.

Be a Finger Print Expert

Build up a business on the basis of a trained brain. You can do it as a master of the Finger Print Profession. There is crying need for Finger Print Experts right now and the demand for these trained men is growing every day. A profession that offers wonderful opportunities for advancement. Governments, corporations, police departments, institutions and individuals have constant use for these specially trained men. The work is fascinating and

The Pay Is Big!

No special education is necessary. You can become a master of this profession by studying at home in your spare time. Expert Finger Print men travel all over the country solving mysteries that baffle all others. They are important men and highly regarded and envied by every one.

Mail the Coupon

Get full information about this great profession and our big offer of a free course in Secret Service Intelligence. The mastery of these two closely allied professions places a brilliant career within your grasp. Achievements that will immediately place the stamp of success upon you, are now possible. Send this coupon for full information NOW.

University of Applied Science

Desk 9204, 1920 Sunnyvale Ave., Chicago
Gentlemen: Without any obligation whatever send me your new FREE book on Finger Prints and your offer of a free course in Secret Service Intelligence.

Name

Address

Age Occupation

AMATEURS ATTENTION!

Send over 25 Miles on D.C.

Here at last is real "commercial type" radio apparatus designed for low power direct current. New transmitting records are in store for you. Take advantage of this special introductory offer and save \$7.50.



THE "AMRAD" INDUCTION COIL

6 Volt or 32 Volt

is almost an exact duplicate of the U. S. Signal Corps coil used in trench service during the war. It has bakelite insulation throughout. Its secondary, wound in 20 sections, produces 50,000 volts. Rated at 100 watts this coil has an output about 100 per cent. greater than the average 2 inch coil. The vibrator is rugged, steady and non-sparking and designed to give a spark frequency equivalent to 100 cycles which means maximum transmitting range on short wave lengths. The 32 volt coil is intended especially for use on farm lighting circuits. When ordered separately this type is \$1 extra. To get maximum results with the 6 volt coil a heavy 6 volt storage battery is the best and most economical source of current.

Price, 6-volt type.....\$28.50

Quenched Gap, carefully operated, yields the secret of long range transmitting on low power. This special gap is identical in design to the heavy $\frac{1}{2}$ k.w. and 1 k.w. Amrad Quenched Gaps now being installed in long distance amateur stations. Not only will this special quenched gap make your transmitter as efficient, for its power, as the more costly equipment but you will be able to send more messages without interfering with other stations. For the first time in the history of amateur radio every induction coil transmitter can now be tuned to comply with Government decrement regulations. The Amrad Quenched Gap is the secret.

Price, Induction Coil Type.....\$12.50

Special Introductory Offer

If you have had limited power at your disposal and inefficient apparatus or if you are waiting to be introduced to the fascination of sending radio messages over into the next county or state here is your chance to get the two most important pieces of transmitting apparatus at an actual saving of \$7.50.

"Amrad" Induction Coil, regular price, . . . \$28.50
 "Amrad" Quenched Gap, " " . . . 12.50
 \$41.00

Special Price for the Double Buy, \$33.50

Either 32-volt or 6-volt coil may be chosen

How to Order Show this advertisement to your dealer and ask him to order one of these combinations for you. If you have no radio dealer in your vicinity send us check or money order for \$5 and we will ship direct to you by parcel post C. O. D., the balance plus postage. Act promptly, as the standard Signal Corps parts which we secured from the Government were only sufficient to make up a limited number of sets. If you are not ready to buy and want further information send for free Bulletin P which contains complete description and operating directions.

Dealers' Opportunity Write at once for short-term trade discount on this combination. No better opportunity to introduce apparatus of such high quality at such low prices will ever be had again. The offer is made especially to introduce our rapidly growing line of "commercial type" radio apparatus.

Address all communications to New York office

AMERICAN RADIO AND RESEARCH CORPORATION
 29 PARK ROW Factory at Medford Hillside, Mass. NEW YORK

Are YOU doomed at 44?



Forty-four years is the average span of man's life in America. The great insurance companies each year write millions of dollars worth of insurance based upon that proven fact.

Most men wear out or break down before their time because of preventable diseases—because they neglect the warnings of Nature that their Vital Machine is out of order. Constipation, dyspepsia, biliousness, weakness, headaches, dizzy spells, inability to remember or concentrate, hardening of the arteries, varicose veins, high blood pressure, etc., are O.S. calls, which, if you don't heed, if you don't break of broken-down humanity before you even reach the prime of life.

Act NOW—before it is too late

Don't go through life, weak, sickly, impotent, unable to enjoy it or benefit by the ability with which Nature has endowed you. Always in discomfort or misery, always the underdog—worn out by either slipping into the great army of the uselessly unfit or of dying before your time. DON'T! It is not necessary. You can get your life back. All ailments or bad habits and put your human machine in A-1 running order. Thousands of other weak, sickly, discouraged men have done.

Don't try to get life out of dead dogs. Pill-feeders never become red-blooded, virile MEN. Quick "remedies" are manufactured for the money they bring their makers. A little temporary relief or stimulation—then the inevitable reaction—and you are back to square one. Millions of dollars are wasted and thousands of lives cut short each year, and the worthless promises of patent medicine fakers.

There's only one safe, sane, sure way back to health, strength, and energy in Nature's way. You have within you the greatest health and energy restoring, revitalizing power the world has ever known, in the tremendous force Nature herself exerts toward upbuilding the human organism, when once you understand her methods and observe her laws.

The principles of Strongtiform are based upon my discovery—that internal muscular activity governs Health, Strength, and Life itself. Most forms of disease are caused from the muscles losing their power of rapid contraction. As these muscles are responsible for holding the internal organs in position, when they are relaxed, the organs gradually fall out of their place and rest upon other organs, upsetting their functioning and causing almost every known form of disease. Strongtiform gives contrite power to the muscles and quickly makes them normal and so draws the sagging organs back to their position.

My whole life has been spent in studying out and developing this Science of Strongtiform. My pupils are located in every civilized country of the world. I can and I will do for YOU what I already have done for them.

Send for my FREE book

"Promotion and Conservation of Health, Strength and Mental Energy" will tell you all about Strongtiform—what it has done for others and what it undoubtedly will do for YOU. It never fails. You can practice Strongtiform in the privacy of your own bedroom and get all the benefit from it. Fifteen to twenty minutes a day will give you a wonderful improvement in a few weeks time.

Send for the book today—NOW. Don't put it off until tomorrow. It's FREE, but if you study what it contains, check for it. If you know what it contains, fill out the coupon and mail with three 2c stamps for packing and postage and I will send you with the book a special letter on the subject on which you are most interested.

LIONEL STRONGTORM

Physical and Health Specialist

1193 Strongtorm Institute, Newark, N. J.

--- CUT OUT AND MAIL THIS COUPON ---

Mr. Lionel Strongtorm, Newark, N. J.

Dear Strongtorm: Please send me your book, "Promotion and Conservation of Health, Strength, and Mental Energy." I am interested in it.

I enclose three 2c stamps to cover mailing expenses. I have marked (X) where the subject in this list interests me.

() Cold () Insomnia () Weakness () Biliousness () Dyspepsia () Constipation () Headaches () Stomach Disorders () Liver Disorders () Nephritis () Rheumatism () Deformities () Bad Habits () Catarrh () Short Wind () Asthma () Flat Feet () Obesity () Stomach Disorders () Thinness () Rupture () Lumbago () Torpid Liver () Neuritis () Nervousness () Pies () Stomach Disorders () Deformities () Rheumatism () Deformities () Bad Habits ()

NAME _____

AGE _____

OCCUPATION _____

STREET _____

CITY _____

STATE _____

have an amplification constant many times larger than this value.

This amplifying property of the tube is due to the grid, and the amplification constant depends on the mesh of the grid. The finer the mesh the higher the amplification constant becomes. At the same time, the grid acts as a sort of screen to the flow of electrons from the filament to the plate, and the finer the mesh of the grid is made the greater becomes this screening effect.

Hence, if we want to increase the amplification constant by making the grid of a closer mesh, we at the same time increase the resistance of the tube.

On the other hand, the resistance of the tube can be decreased by increasing the plate potential (as will be explained later). When the tube has a high amplification constant, it is therefore, in general, desirable to operate it with high plate voltages. Theoretically there is hardly any limit to the voltage amplification that can be produced by a tube. Of course, a transformer can also be looked upon as a voltage amplifier, because an ordinary step-up transformer will step up the voltage; but there will generally be some loss of power, whereas in the case of the tube the A.C. power is amplified. Generally speaking, it follows from Fig. 4 that the best way to obtain large voltage amplification is to make the resistance or impedance in the plate circuit large compared with the resistance of the tube itself.

Right Circuits for Amplifying

This is different from the case in which the tube is used as a power amplifier, because the power amplification is a maximum when the external impedance is equal to the resistance of the tube. The amount of power amplification given by most tubes used in practice is of the order of several hundred; but vacuum-tube amplifiers have been made that will give a power amplification of several thousand.

It is perhaps known that vacuum tubes will amplify without appreciably distorting the wave form. This is, however, true only if special precautions be taken to operate the tube in the proper kind of circuit.

It will, for example, readily be seen by referring to Fig. 3 that if an



Fig. 5. A hook-up used in studying the function of a resistance in the plate circuit

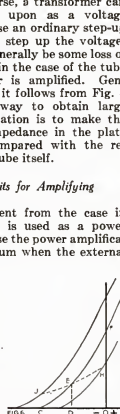


Fig. 6. Showing how plate current depends on plate-circuit voltage and also on the grid voltage. The dotted line J E H is a dynamic characteristic

LEARN PIANO TUNING

Making Tunes of True Tone by Tuning-Piano

Capitalize YOUR Ability

THE WORLD PAYS FOR SKILL

This profession now offers unusual opportunities for making money. As it is uncrowded, your time is your own. Our Correspondence Course with notes and the wonderful Tuning-Piano, our patented instrument of precision in sound, make the seemingly difficult easy to understand by anyone. Diploma given graduate. 16 years' experience in correspondence teaching. Write for free book.

MILES BRYANT SCHOOL OF PIANO TUNING
1507 So. Arts Institute, BATTLE CREEK, MICHIGAN

BE AN ARTIST

We can teach you DRAWING in 30 days

Our 18 years of successful teaching prove our ability.

Our Course in Commercial and Illustrative Drawing is Endorsed by highly authoritative artists.

Students trained by members of our Faculty are filling high-salaried positions in Artistic Drafting, etc.

Write today for Art Year Book.

SCHOOL OF APPLIED ART
APPLIED ART BLDG., No. 8 BATTLE CREEK MICH.

NINE MONTHS TO PAY

Immediate possession on our liberal terms. Monthly payments of \$10.00 per month.

Offering a wide variety of goods at low prices.

Offering a wide variety of goods at low prices.

Offering a wide variety of goods at low prices.

Offering a wide variety of goods at low prices.

Offering a wide variety of goods at low prices.

Offering a wide variety of goods at low prices.

Offering a wide variety of goods at low prices.

Offering a wide variety of goods at low prices.

Offering a wide variety of goods at low prices.

Offering a wide variety of goods at low prices.

Offering a wide variety of goods at low prices.

Offering a wide variety of goods at low prices.

Offering a wide variety of goods at low prices.

Offering a wide variety of goods at low prices.

Offering a wide variety of goods at low prices.

Offering a wide variety of goods at low prices.

Offering a wide variety of goods at low prices.

Offering a wide variety of goods at low prices.

Offering a wide variety of goods at low prices.

Offering a wide variety of goods at low prices.

Offering a wide variety of goods at low prices.

Offering a wide variety of goods at low prices.

Offering a wide variety of goods at low prices.

Offering a wide variety of goods at low prices.

Offering a wide variety of goods at low prices.

Offering a wide variety of goods at low prices.

Offering a wide variety of goods at low prices.

Offering a wide variety of goods at low prices.

Offering a wide variety of goods at low prices.

Offering a wide variety of goods at low prices.

Offering a wide variety of goods at low prices.

Offering a wide variety of goods at low prices.

PATENTS

Terms Reasonable

Write for free booklet

Highest References

Best Results

Send model or drawing for preliminary examination and report as to patentability

ALL BUSINESS GIVEN PROMPT AND PROPER ATTENTION

WATSON E. COLEMAN, Patent Lawyer, 624 F St., Washington, D.C.

U.S. PATENTS

SEND FOR THIS FORM

DON'T LOSE YOUR RIGHTS TO PATENT PROTECTION

Before disclosing your invention to anyone send for blank form "EVIDENCE OF CONCEPTION" to be signed and witnessed. A sample form together with printed instructions will show you just how to work up your evidence and establish the same before filing application for patent. As registered patent attorneys we represent hundreds of inventors all over the United States and Canada in the advancement of inventions. Our schedule of fees will be found reasonable. The form "Evidence of Conception," sample, instructions relating to obtaining of patents and schedule of fees sent upon request. Ask for them, a post card will do.

PATENTS AND TRADE MARKS
LANCASTER & ALLWINE

274 Ouray Bldg.
WASHINGTON, D. C.
Originators of form "Evidence of Conception."

PATENTS

TRADE-MARKS

COPYRIGHTS

Send for free book of patent information

Beale & Park
1416 F St., Washington, D. C.
16 S. Broad St., Philadelphia, Pa.

DO YOU KNOW EVERY MOVE YOUR ATTORNEY MAKES? INVENTORS

My clients are immediately informed of every step in the prosecution of their applications.

Write Now **PATENTS** Send Sketch
Office of **WARNER I. CUMBERLEY**, Patent Attorney,
30 National Union Bldg., Wash., D. C.

CONSTRUCTION OF INDUCTION COILS AND TRANSFORMERS.
By Thomas Steiner Curtis. Full of practical notes and instructions. Tells you build the only and the best. Little is left to guess work. Open and closed core transformers are both taken up. For a practical in-struction book on the whole subject this is a hard to beat for the price. 25 cents.

POPULAR SCIENCE MONTHLY New York
228 West 39th Street

PATENTS

WRITE
FOR
THIS
FORM

INVENTOR'S BULLETIN

Sent Without Charge

MY FREE BLANK FORM INVENTOR'S RECORD

For Disclosing Your Idea
SIMPLIFIES PROCEDURE

WILLIAM H. MULLIGAN
REGISTERED ATTORNEY

392 Woodward Bldg., Washington, D. C.



The Book

for Inventors and Manufacturers

By return mail FREE.
Write **LACEY & LACEY**
Dept. M Washington, D.C.

PATENTS PROCURED AND TRADE-MARKS REGISTERED

Twenty Years' Experience. Instructions and Terms on request.

ROBB, ROBB & HILL, Attorney at Law
Specializing in Patent and Trade-mark Practice exclusively
840 McLachlin Bldg., 1336 Schofield Bldg.,
Washington, D. C. Cleveland, Ohio.

PATENTS

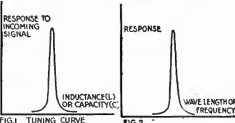
IF YOU HAVE AN INVENTION AND DESIRE TO LEARN HOW TO SECURE A PATENT, send for Our Guide Book, HOW TO GET A PATENT, sent Free on request. Tells our Terms, Methods, etc. Send model or sketch and description of your invention and we will give our opinion as to its patentable nature.

RANDOLPH & CO.
130 F St., N. W., Washington, D. C.

NAME.....
STREET.....
CITY.....STATE.....

Stoppers and Filters for Undamped Waves

UNDAMPED waves are so generally used today that amateur and professional alike are becoming interested in ways for selecting a desired wave length and excluding an interfering wave. In the last year or so several patents have been issued that describe methods and means for



Showing how the intensity of an incoming signal depends on tuning of the receiving set

discriminating against wave trains of one range of frequency in favor of trains of another range. Some of these methods are very complicated and require considerable accurately constructed apparatus, as is the case of the method described by G. A. Campbell in United States Patent 1,227,113.

It is amazing, however, how much can be done with a simple tuned circuit, formed by a coil and a condenser, if one fully understands its operation. Every radio enthusiast knows how to tune such a circuit by varying either the inductance or the capacity. When listening to a continuous wave station he finds that as he varies L or C his set passes through an adjustment where the response is greatest. The curve showing this change is the familiar one of Fig. 1.

If the tuning is fixed in some adjustment, and signals of different wave lengths are observed, it will be found that the response goes through variations of intensity like those of Fig. 2. Of course, to test this, one should have an oscillator the frequency of which he may change continuously without changing the output; for the curve of the figure assumes that the incoming signal is always of the same intensity when it reaches the circuit under test.

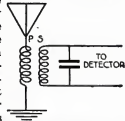


FIG. 3 RECEIVING CIRCUIT

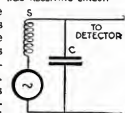


FIG. 4 ELECTRICAL EQUIVALENT OF FIG. 3

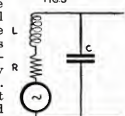


FIG. 5 ELECTRICAL EQUIVALENT OF FIG. 4

Circuit diagrams that help to show why tuning the receiving set is important

We make use every day of this fact that a definite tuning corresponds to a definite wave length. What is its explanation? In the tuned circuit of Fig. 3, a voltage is induced in the coils by the current that the incoming wave sets up in the antenna. As far as concerns the tuned circuit and the detector, the effect is the same as if a generator of the signal frequency were connected to the coil as shown in Fig. 4. It is easier to understand what happens in the circuit if in our minds we separate the resistance of the coil S from the inductance. To help in so doing we sometimes draw the coil in two parts, as in Fig. 5, one part a resistanceless inductance L , and the other a non-in active resistance R .

The voltage required to send an alternating current through an inductance is always just opposite to that required to send the same alternating current through a condenser. When the inductance and the capacity form a circuit tuned to the frequency of the alternating current, then the

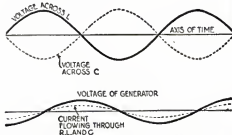
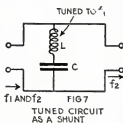


FIG 6 VOLTAGES AND CURRENT IN A TUNED CIRCUIT

This plot shows why a tuned circuit gives a maximum response. No voltage is required to send a current through the inductance and capacity. Only the resistance requires a voltage to give a current

voltages required by the inductance and the capacity are not only just opposite, but are also always just equal. The result is that it doesn't require any voltage to send an alternating current through an inductance and a condenser, connected in series, if they are tuned to the frequency of the source of the voltage. Voltage is then required only to force current through the resistance of the circuit. In Fig. 5, then, all the voltage of the generator is effective in sending an alternating current through the resistance;

and the current that flows around the circuit of R , L , and C is just that which the whole voltage of the generator could send through the resistance alone. If we obtained a picture on the moving film of an oscillograph of the values of the voltages and the current in such a tuned circuit, it would be like Fig. 6.



A tuned circuit used as a by-pass

Pre-eminence of American Inventions



Telephone



Typewriter



Recording Adding Machine



Cash Register



Motion Picture Machine



Incandescent Lamp



Motion Picture Film



Talking Machine



Electrolytic Alkali Production



Electric Furnace Reduction

OF the epoch-making inventions of the world during the last half century, more than fifty in number, Americans are credited with thirty-five, which include the Telephone, Typewriter, Cash Register, Incandescent Lamp, Talking Machine, Electric Furnace Reduction, Electrolytic Alkali Production, Transparent Photographic Film, Motion Picture Machine, Button-hole Sewing Machine, Carborundum, Chain Stitch Sewing Machine, Single Type Composing Machine, Continuous Process Match Machine, Chrome Tanning, Disk Plow (modern type), Welt Machine, Electric Lamp, Recording Adding Machine, Celluloid, Automatic Knot-Tying Machine, Machine for Making Barbed Wire, etc.

America leads the world in invention and must maintain its supremacy in the future.

To the Man With an Idea

I offer a comprehensive, experienced, efficient service for his prompt, legal protection and the development of his proposition.

Send sketch, or model and description, for advice as to cost, and search through prior pertinent United States patents. Preliminary advice gladly furnished without charge.

My experience and familiarity with various arts frequently enable me to accurately advise clients as to probable patentability before they go to any expense.

Booklet of valuable information and form for properly disclosing your idea free on request.

RICHARD B. OWEN, Patent Lawyer

6 Owen Building, - - - Washington, D. C.
2776D Woolworth Building, - - New York City

PATENTS

IF YOU HAVE AN INVENTION which you wish to patent, you can write fully and freely to Munn & Co. for advice in regard to the best way of obtaining protection. Please send sketches or a model of your invention and a description of the device, explaining its operation.

All communications are strictly confidential. Our vast practice, extending over a period of seventy years, enables us in many cases to advise in regard to patentability without any expense to the client. Our Hand-Book on Patents is sent free on request. This explains our methods, terms, etc., in regard to Patents, Trade Marks, Foreign Patents, etc.

If you are a reader of SCIENTIFIC AMERICAN

you are probably aware of the fact that it has been known to the inventor. Each issue contains a description of a large number of recently patented inventions. Pending patent legislation as well as the most recent rulings of the Patent Office and the courts are considered in its columns.

MUNN & CO.

SOLICITORS OF PATENTS

683 Woolworth Building, New York
624 F Street, Washington, D. C.
Tower Building - Chicago, Ill.
Hobart Bldg., 582 Market Street,
San Francisco, Calif.

PATENTS and Trade Marks

Send sketch or model for actual search and report. Write for Booklet of instructions on patent practice and procedure. Prompt personal service. . . .

Geo. P. Kimmel Patent Lawyer

39-E Loan and Trust Building, Washington, D.C.

Deafness

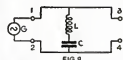


Perfect hearing is now being restored in every condition of deafness or defective hearing from causes such as Catarrhal Deafness, Thickened Drums, Roaring and Hissing Sounds, Perforated, Wholly or Partially Destroyed Drums, Discharge from Ears, etc.

Wilson Common-Sense Ear Drums
"Little Wireless Phones for the Ears" require no medicine but effectively replace what is lacking or defective in the natural ear drums. They are simple devices, which the wearer easily fits into the ears where they are invisible. Soft, safe and comfortable.
Write today for our 168 page FREE book on DEAFNESS, giving you full particulars and testimonials.
WILSON EAR DRUM CO., Incorporated
554 Lusk Southern Bldg., Louisville, Ky.

The reason we use a tuned circuit to supply a detector is apparent at once when we remember that the detector is connected across the condenser, and that across the latter there will be the greatest voltage when the current through it is greatest. As we have just seen, the current through the entire circuit is greatest when tuned to the frequency of the voltage source.

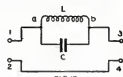
If an inductance and a condenser have the proper values to form a tuned circuit like that of Fig. 3, and to give a maximum response for a signal of frequency f_1 , then we know that this coil and condenser in series act to waves of frequency f_1 , just like a small resistance. If connected as in Fig. 7 they will form a short circuit to any waves of frequency f_1 that we try to send through from terminals 1-2 to terminals 3-4. If wave trains of this frequency and of some other, as f_2 , are impressed on the left-hand terminals, only the train of frequency f_2 will pass through, for the other will be short-circuited or "by-passed." It is only for the single frequency for which L and C are tuned that the circuit will act like a short-circuiting resistance. For frequencies above or below it will be less and less effective as a by-pass, as is shown in Fig. 8. This relation is obtained by connecting a generator, as in Fig. 9, to one side and measuring the voltage on the other pair of terminals. The voltage impressed by the generator must be kept constant while its frequency is varied.



CONNECTIONS FOR TESTING

The plot may be obtained by calculation or by actual measurements with the circuit shown above

The tuned circuit is connected to stop the flow of current of its own frequency



STOPPER CIRCUIT

An inductance and a condenser that have been tuned to a definite frequency may also be used as a "stopper" in series with any desired portion of a radio circuit by connecting as in Fig. 10. Notice that the condenser and inductance are in parallel with each other, but that the combination is now in series with the circuit that it is to protect from waves of its own frequency. This circuit a so has the characteristic of Fig. 8.

To see the reason we look back to Fig. 6, and remember that a condenser and an inductance are carrying the same alternating current the

VOLTAGE AT
TERMINALS 3-4

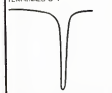


FIG. 9. SHOWING TRANSMISSION THROUGH THE CIRCUIT OF FIGURE 9

The by-pass circuit shunts out waves of its own frequency

reason we look back to Fig. 6, and remember that a condenser and an inductance are carrying the same alternating current the

CAN YOU

think of a simple, practical idea that will fill one of the many requests we have on file for new inventions? It may mean a fortune for you. Thousands of things are needed Right Now. Your brain can help. Send today for our great new book—"Inventions and Trade Marks, Their Protection and Exploitation"—and learn more about making money from ideas than you ever knew before. It tells many things that are wanted.

too. A postal will do—
it is free.

We help our clients, without charge, to get the dollars out of their ideas—having facilities none others possess.

Advice free.
Don't delay—get the book at once.

AMERICAN
INDUSTRIES, INC.

201 Patent Dept.,
WASHINGTON, D. C.

PATENTS ADVERTISED FOR SALE FREE

In INVENTION AND
MANUFACTURING
SUPPLEMENT.

Published for the
man with an idea.
Send for free sample
copy. One year's sub-
scription 50c.

PATENTS

Free Book on Patents

Before applying for a patent write for a Free Copy of our book "How to Obtain a Patent," which contains valuable information and advice to inventors. It tells how to secure Patents. Send a model or sketch of your invention for our "Evidence of Conception" form and our opinion of its patentable nature—Free. Twenty years' experience in patent matters. Write today for your FREE BOOK.

TALBERT & TALBERT Patent Lawyers

4621 Talbert Bldg., WASHINGTON, D. C.

FREE BOOK Learn Piano!

This Interesting Free Book shows how you can become a skilled player at piano or organ in just one hour. At one quarter the cost of any other piano or organ method. Written Method is complete, teaching all steps in learning to play. Some, Scientific and easy to understand. Fully illustrated. For teachers, students, or parents. All music free. Write today for this free book. "How to Play Piano".
M. L. GUNN, Conservatory, Studio 23, Social Union Bldg., Boston, Mass.

AIRPLANE SCHOOL

America's Coming Biggest Industry. Big Demand for Combination Engineers and Motor Men. Earn \$15 a week and on. Complete Instruction. New planes and Aeronautical Equipment. War planes for sale at \$1 original cost. WRITE for Free Particulars. National Airplane School, 5127 E. 6th, Kansas City, Mo.

STUDENTS PUBLISHES cash art assignments. MAGAZINE lessons and articles on Cartooning, Designing, Illustrating, Lettering and Chalk-Talking. Critiques amateurs' work. Full of information for artists and art students. Satisfactory or money refunded. 20c a copy, \$1 a year. Send \$1 NOW, Thrift Stamps Taken. G. B. LOCKWOOD, Editor, Dept. 595 Kalamazoo, Mich.

voltage impressed on them must always be opposite. Of course, we can turn this around and say that if we impress the same voltage on a condenser and on an inductance the current in the condenser will always be opposite to that in the inductance. Now, in Fig. 10 the same voltage must be impressed on both, since they are in parallel. The current in the condenser is then opposite to that in the inductance. If the frequency of the source of voltage which is connected to terminals 1-2 is that for which the circuit is tuned, these currents are not only opposite but always equal. At a junction point like *b*, where the currents join to flow outward to terminal 3, the two currents will always just neutralize each other. In other words,

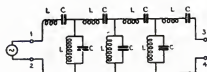


FIG. 11
ONE FORM OF CAMPBELL FILTER

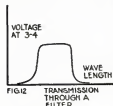
A very efficient circuit for passing waves of preassigned frequencies

no current of this frequency can flow along the wire 1-3, and hence none from terminals 1-2 to 3-4. In actual practice, however, the inductance has some resistance, and so the currents in the branches do not exactly balance.

The radio operator who understands these circuits can do all sorts of stunts with a vacuum-tube oscillator or modulator, picking up any harmonic frequency that he may select.

A very effective circuit for cutting out a given range of frequencies may be built by combining shunt-and-series tuned circuits in the manner that G. A. Campbell describes in his patent. He connects a number of similar elements as in Fig. 11, and by so doing obtains an immense advantage, which

is shown by the characteristic curve of Fig. 12. This "filter," as he calls it, will pass not only a single frequency, but as wide a range of frequencies as one wishes; and all get through with about the same



The circuit here gives the flat-topped turning curve as shown

intensity if their sources have the same intensity.

Such a filter is of particular use in dealing with telephony, whether wire or radio; for the human voice requires for its intelligible transmission a considerable range of frequencies. The inventor shows a number of other forms of filters, but all require calculations the mathematics of which is beyond many amateurs. This need not bother the amateur much, however, for he can obtain good results by using the convenient circuits that are explained above.

PATENTS TRADE-MARKS AND COPYRIGHTS

SPECIAL OFFER FREE OPINION AS TO PATENTABLE NATURE

Before disclosing an invention, the inventor should write for our blank form "Evidence of Conception." This should be signed and witnessed and if returned to us together with model or sketch and description of the invention, we will give our opinion as to its patentable nature.

Our Three Books Mailed Free to Inventors

Our Illustrated Guide BOOK

HOW TO OBTAIN A PATENT

Sent FREE on Request

Contains full instructions regarding Patents, Trade-Marks, Foreign Patents. Our Methods, Terms, and 100 Mechanical Movements illustrated and described, Articles on Patent Practice and Procedure, and Law Points for inventors.

OUR TRADE MARK BOOK

Shows the value and necessity of Trade-Mark Protection and gives information regarding unfair competition.

OUR FOREIGN BOOK

We have Direct Agencies in all Foreign Countries. Write for our illustrated Guide Book on Foreign Patents.

SPECIALIZATION Our Staff

The field of invention is so vast that it is impossible for any one man to become an expert in all the different classes of invention. Only those practically skilled in the class to which the invention relates are capable of rendering efficient service. For this reason Victor J. Evans & Co. employ a number of patent lawyers and mechanical experts who have been selected for their special knowledge and ability in certain lines of invention.

THE VALUE OF YOUR PATENT

Will depend much upon the skill and care with which your case is prosecuted in the United States Patent Office. This work will receive the benefit of skill and experience acquired by a long and successful practice. We spare neither time nor pains to secure the broadest possible patents that the inventions will warrant. But to do this in some cases requires time and labor, and while you will sometimes have to wait, we will have to both wait and work. That every case entrusted to us receives our best efforts, and that our work is done consistently, skillfully and thoroughly is evidenced by the many unsolicited letters of commendation that we receive constantly from our clients. We will furnish upon request lists of clients from any State in the Union for whom we have secured patents.

Our New York, Philadelphia, Pittsburgh and Chicago Offices

Owing to the growth of our business we have established for the benefit of our clients Branch Offices in New York City, Philadelphia, Pa., Pittsburgh, Pa., and Chicago, Ill. These branch offices being located in these large commercial cities, together with our Main Office located near the U. S. Patent office, in Washington, enables us to more promptly handle the business of our clients, particularly as the branch offices are in constant touch with the Main Office and fully equipped to handle patent business in all its branches.

Highest References—Prompt Attention—Reasonable Terms

FREE COUPON

VICTOR J. EVANS & CO. Patent Attorneys

New York Office: 1007 Woolworth Bldg. Philadelphia Office: 135 S. Broad Street Pittsburgh Office: 514 Empire Bldg.

Chicago Office: 1114 Tacoma Bldg.

Main Offices, 760 9th Street, Washington, D.C.

Gentlemen: Please send me FREE OF CHARGE your books as described above.

Name.....Address.....

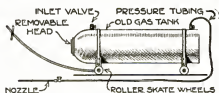


An Air-Pressure Grease Supply for Garages

NO one enjoys the job of cleaning out the grease and hard oil that gets into the transmission-case and the differential housing, and one man avoided it by devising a grease supply that was always on tap, with good air-pressure back of it.

An old self-filling gas-tank, the kind that may be replenished with chemicals when needed, was used for the air and grease chamber. This had been provided with a removable cap at one end, held in place by two bolts, as shown in the sketch, and through which the grease was supplied to the tank.

At the bottom, as shown, a quarter-inch hole was bored and fitted with a four-inch length of gas-pipe, which in turn was connected with a length of



Showing how an old gas-tank formerly used for illuminating purposes can be converted into an air-pressure grease-gun

pressure hose. At the other end of the hose, a long nozzle was also connected, and had in itself a pet-cock for turning off the grease when desired. This long nozzle was made of brass tubing, rolled down to the shape shown. The pet-cock was of the wedge variety, and was screwed to the end of the nozzle, being placed between the nozzle and the hose.

Another hole was drilled through the side of the tank, near the top, tapped, and an old tire valve screwed in for the air intake.

In use, the head of the tank was removed, a gallon of hard oil put in, and puddled to give it a tendency to run and keep at the bottom, the head replaced, and air driven into the chamber by applying the end of the air hose to the tire valve. From thirty to eighty pounds pressure was found necessary, depending upon the viscosity of the grease used.

Then, by simply turning the cock in the end of the outlet line, grease was delivered at any point in a constant stream.

To increase its usefulness further and to save time, the tank was mounted upon a truck, with the wheels from an old roller-skate for the mounting.

In refilling, and to prevent wasting grease when the cap was removed, the core of the tire valve was loosened, letting out the extra air, before the cap was taken off, preparatory to putting in more grease.

The tank was wheeled to the place to be used and then tipped upon end, forcing all of the grease to the bottom.—DALE VAN HORN.



The Things That Bigger Pay Will Bring You

You want these things and probably many others, so why don't you double and treble your pay? **You can do it.** With double and treble the amount you are now earning you can go to the bank each pay day and put away a sum of money for a "rainy day," or that can be used for profitable investments or building your own home. Bigger pay would enable you to own an automobile and to get many pleasures out of life that you cannot now afford. To be able to go to the bank each pay day and steadily build up a bank account **without missing it** is alone worth any effort it may take to increase your earning power. Then think of the things you want that are not pictured here. Whether you ever enjoy those things depends entirely on yourself.

Every day you see men around you stepping up into better jobs and drawing bigger pay. It isn't a question of "how do they do it?" You

know they have trained themselves to handle the jobs ahead of them. The question is "WHY DON'T YOU DO IT?" You want the things that better pay will bring you so why not decide NOW to prepare yourself for a better job and better pay?

Don't Dodge a Better Job

Promotion and better pay is up to you and not the boss. The big pay checks go to those who can think, act and do things for themselves. Training will make you a master of your work and **place you in the job you want.** There are no two ways about it; while you ignore the benefits of training you are **dodging a better job.** Without interfering with your work you can prepare for bigger pay right in your own home—after supper in some of the hours you now waste. The thousands who have marked and mailed the Coupon to the right have doubled and trebled their pay. That is just what you can do—so do as they did. Send the Coupon.

AMERICAN SCHOOL OF CORRESPONDENCE

Dept. G-754, Chicago



Please send me booklet and tell me how I can do myself for position marked X.



- | | |
|----------------------------------|-----------------------------|
| High School Graduate | Employment Manager |
| Western Union Courses | Steam Engineer |
| Telephone Engineer | Lawyer |
| Draftsman and Designer | Business Manager |
| Automobile Engineer | Certified Pub. Accountant |
| Automobile Repairman | Accountant and Auditor |
| Aircraft Mechanic | Bookkeeper |
| Fire Insurance Expert | Stenographer |
| Sanitary Engineer | General Education Course |
| Photoplay Writer | Com. School Branches |
| Heating and Ventilating Engineer | Electric Light and Power |
| Master Plumber | Superintendent |
| Civil Engineer | Hydroelectric Engineer |
| Structural Engineer | Welder Operator |
| Mechanical Engineer | Architect |
| Shop Superintendent | Building Contractor |
| | (Foreman's Training Course) |

Name _____

Address _____

What You Should Know When Working Hard Wood

By G. F. Collins

THERE are few carpenters whose lot it is to handle nothing but soft woods throughout life, and it is of interest to see in what way the hard wood differs from the soft.

In the first place, hard wood cannot be shaped with dull tools, and the harder the wood in use, the sharper must be the tool. Thus the first essential is well filed and pointed teeth on saws and keen edges on planes and chisels.

You Will Need Special Tools

The tools, are special; that is, the old-fashioned wide-mouthed planes, with their chattering irons and cutters, will not act on timber the fiber of which is



Trimming hard wood has its difficulties, and it must be done deliberately and without haste

dense, lengthy, or erratic. Therefore iron and composite iron-and-wood planes will be found to work faster and better than the old beech planes.

Trimming in hard wood has its difficulties, and must be done without too much haste. For instance, with jambs, especially with the inside 1/2-in. jambs in stud partitions, the most common difficulty met is the twisting or bending of the piece, caused either by imperfect drying or by the pieces warping from being brought from a dry, warm atmosphere into the dampness of a newly plastered building. Often, in this case, the worker finds it almost impossible to draw the face of the jamb straight without splitting it, but

it can be easily done if a few saw kerfs are run across the back of the jamb to a depth of about half its thickness.

A similar treatment is applicable for twisted or warped casings; but when molded the kerfs should not be so deep as to show on the face, which would effectually destroy the piece. Maple, oak, hazel, white mahogany, butternut, basswood, hard yellow pine, and ash all show this tendency.

How to Nail Hard Wood

Another important factor in hard wood is nailing. Even with wire nails, it is safest to bore the stuff with a drill, especially at the ends, where its brittleness makes it most liable to split, and in nailing it is

well to have the stuff solidly placed against the plaster furring, or whatever may be behind it, in order that it may not jar under the impact of the hammer.

The use of a small pointed nail-set is desirable in hard wood; or at least the point of the set should be less in diameter than the head of the nail, as a set too large will split out the stuff. All nails should be driven through the thick part of the stuff and not through the thin; if it is too thick, it should be bored first, but when nailed through the thin portions it is liable to spring out and split when working under atmospheric changes.

If the best should come to you tonight to fight for your life for the safety of a loved one, would you know how to strike an offensive blow and put the weight of the body behind it? Would you know your opponent with its view or hand-breaking hold? Isn't it a fact that you are not ready? I will teach you how to learn.

Who wants to learn boxing at home?

If you remonstrate with a bully for striking a smaller man, and he turns on you, can you hold your own? Wouldn't you like to?

If you are walking with your mother, sister, or best girl, and some one passes a slighting remark, or uses improper language, wouldn't you like to stand up for yourself? Well, can you?

Less than 2% of the men and boys in this country know anything about the art of self-defense. Only 2% of our trained athletes know how to box. That means when someone says, "Come put on the gloves," less than 2% are fit and ready.

Wouldn't you like to learn how to box? Wouldn't you like to learn easily and quickly—right in your own home—less than half the cost of a single term of lessons by the old method?

I have developed a unique "shortcut" method of teaching boxing. You can learn the fundamentals in 6 lessons, and run outlast older and stronger opponents after two weeks' study. My original method has enabled me to teach professional boxers difficult blows and guards they could not learn by the old method. Professor Mike Donovan heartily endorsed this "shortcut" method and helped me prepare the lessons I send you. Boxing instructors and Y. M. C. A. physical directors are taking the course to use in their own gyms, and are urging their pupils to take it to save time and money.

I start you with movements you are familiar with—holding out your hand for a coin, the breast stroke in swimming, etc. The first thing you know, I have you striking correct blows, putting wrists and arms behind them, carrying blows, ducking, fencing, etc. I teach you the rudiments in front of your mirror before you face your first opponent. When you finally get up against an opponent, you know how to hit, what to expect in return, and how to avoid getting hit.

It's almost unbelievable. But you can find out whether it's true without paying any money. I will send you my course on demand—that's my way of overcoming your doubt.

The cost is less than you would pay for a single term of lessons. I will include instruction in three rounds on the subject of boxing—break-breaking and jiu-jitsu holds, effective standing wrestling holds and guards for three rounds on the subject of daily exercises to keep you in good physical condition. I will send you Mike Donovan's "How to Box" on boxing technique and guards. If, after five days' examination, you do not want the course, you can send it back to me and no questions asked. If you want to keep the course, the Special Home Study Edition is only \$5, instead of the former price of \$10.

But you needn't send me any money. I will mail the coupon for a free trial to the Marshall Stillman Association, P. O. Box 461, New York, N. Y.

— Free Trial Coupon —

Marshall Stillman Assn., Suite F-4, 461 Fourth Ave., New York

You may send me on five-day approval your complete course in Boxing, including five "Shortcuts" in Boxing and Boxing Lessons, one set of daily exercises, three rounds of boxing, night break-breaking holds and guards, ducking, holding in standing wrestling, and a free copy of Professor Mike Donovan's Book, "The Science of Boxing."

I will either return the course, or remit \$5 in full payment within five days after its arrival.

Name _____

Address _____

City _____

State _____

Zip _____

Clearstone Phonographs

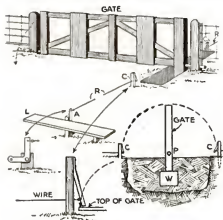
\$4.00 to \$200.00 Retail

Our Specialty Days, after Monday, 20 per cent off.

Special 100 Records for \$10.00. Special 200 Records for \$18.00. Special 300 Records for \$25.00. Special 400 Records for \$32.00. Special 500 Records for \$39.00. Special 600 Records for \$46.00. Special 700 Records for \$53.00. Special 800 Records for \$60.00. Special 900 Records for \$67.00. Special 1000 Records for \$74.00. Special 1100 Records for \$81.00. Special 1200 Records for \$88.00. Special 1300 Records for \$95.00. Special 1400 Records for \$102.00. Special 1500 Records for \$109.00. Special 1600 Records for \$116.00. Special 1700 Records for \$123.00. Special 1800 Records for \$130.00. Special 1900 Records for \$137.00. Special 2000 Records for \$144.00. Special 2100 Records for \$151.00. Special 2200 Records for \$158.00. Special 2300 Records for \$165.00. Special 2400 Records for \$172.00. Special 2500 Records for \$179.00. Special 2600 Records for \$186.00. Special 2700 Records for \$193.00. Special 2800 Records for \$200.00. Special 2900 Records for \$207.00. Special 3000 Records for \$214.00. Special 3100 Records for \$221.00. Special 3200 Records for \$228.00. Special 3300 Records for \$235.00. Special 3400 Records for \$242.00. Special 3500 Records for \$249.00. Special 3600 Records for \$256.00. Special 3700 Records for \$263.00. Special 3800 Records for \$270.00. Special 3900 Records for \$277.00. Special 4000 Records for \$284.00. Special 4100 Records for \$291.00. Special 4200 Records for \$298.00. Special 4300 Records for \$305.00. Special 4400 Records for \$312.00. Special 4500 Records for \$319.00. Special 4600 Records for \$326.00. Special 4700 Records for \$333.00. Special 4800 Records for \$340.00. Special 4900 Records for \$347.00. Special 5000 Records for \$354.00. Special 5100 Records for \$361.00. Special 5200 Records for \$368.00. Special 5300 Records for \$375.00. Special 5400 Records for \$382.00. Special 5500 Records for \$389.00. Special 5600 Records for \$396.00. Special 5700 Records for \$403.00. Special 5800 Records for \$410.00. Special 5900 Records for \$417.00. Special 6000 Records for \$424.00. Special 6100 Records for \$431.00. Special 6200 Records for \$438.00. Special 6300 Records for \$445.00. Special 6400 Records for \$452.00. Special 6500 Records for \$459.00. Special 6600 Records for \$466.00. Special 6700 Records for \$473.00. Special 6800 Records for \$480.00. Special 6900 Records for \$487.00. Special 7000 Records for \$494.00. Special 7100 Records for \$501.00. Special 7200 Records for \$508.00. Special 7300 Records for \$515.00. Special 7400 Records for \$522.00. Special 7500 Records for \$529.00. Special 7600 Records for \$536.00. Special 7700 Records for \$543.00. Special 7800 Records for \$550.00. Special 7900 Records for \$557.00. Special 8000 Records for \$564.00. Special 8100 Records for \$571.00. Special 8200 Records for \$578.00. Special 8300 Records for \$585.00. Special 8400 Records for \$592.00. Special 8500 Records for \$599.00. Special 8600 Records for \$606.00. Special 8700 Records for \$613.00. Special 8800 Records for \$620.00. Special 8900 Records for \$627.00. Special 9000 Records for \$634.00. Special 9100 Records for \$641.00. Special 9200 Records for \$648.00. Special 9300 Records for \$655.00. Special 9400 Records for \$662.00. Special 9500 Records for \$669.00. Special 9600 Records for \$676.00. Special 9700 Records for \$683.00. Special 9800 Records for \$690.00. Special 9900 Records for \$697.00. Special 10000 Records for \$704.00. Special 10100 Records for \$711.00. Special 10200 Records for \$718.00. Special 10300 Records for \$725.00. Special 10400 Records for \$732.00. Special 10500 Records for \$739.00. Special 10600 Records for \$746.00. Special 10700 Records for \$753.00. Special 10800 Records for \$760.00. Special 10900 Records for \$767.00. Special 11000 Records for \$774.00. Special 11100 Records for \$781.00. Special 11200 Records for \$788.00. Special 11300 Records for \$795.00. Special 11400 Records for \$802.00. Special 11500 Records for \$809.00. Special 11600 Records for \$816.00. Special 11700 Records for \$823.00. Special 11800 Records for \$830.00. Special 11900 Records for \$837.00. Special 12000 Records for \$844.00. Special 12100 Records for \$851.00. Special 12200 Records for \$858.00. Special 12300 Records for \$865.00. Special 12400 Records for \$872.00. Special 12500 Records for \$879.00. Special 12600 Records for \$886.00. Special 12700 Records for \$893.00. Special 12800 Records for \$900.00. Special 12900 Records for \$907.00. Special 13000 Records for \$914.00. Special 13100 Records for \$921.00. Special 13200 Records for \$928.00. Special 13300 Records for \$935.00. Special 13400 Records for \$942.00. Special 13500 Records for \$949.00. Special 13600 Records for \$956.00. Special 13700 Records for \$963.00. Special 13800 Records for \$970.00. Special 13900 Records for \$977.00. Special 14000 Records for \$984.00. Special 14100 Records for \$991.00. Special 14200 Records for \$998.00. Special 14300 Records for \$1005.00. Special 14400 Records for \$1012.00. Special 14500 Records for \$1019.00. Special 14600 Records for \$1026.00. Special 14700 Records for \$1033.00. Special 14800 Records for \$1040.00. Special 14900 Records for \$1047.00. Special 15000 Records for \$1054.00. Special 15100 Records for \$1061.00. Special 15200 Records for \$1068.00. Special 15300 Records for \$1075.00. Special 15400 Records for \$1082.00. Special 15500 Records for \$1089.00. Special 15600 Records for \$1096.00. Special 15700 Records for \$1103.00. Special 15800 Records for \$1110.00. Special 15900 Records for \$1117.00. Special 16000 Records for \$1124.00. Special 16100 Records for \$1131.00. Special 16200 Records for \$1138.00. Special 16300 Records for \$1145.00. Special 16400 Records for \$1152.00. Special 16500 Records for \$1159.00. Special 16600 Records for \$1166.00. Special 16700 Records for \$1173.00. Special 16800 Records for \$1180.00. Special 16900 Records for \$1187.00. Special 17000 Records for \$1194.00. Special 17100 Records for \$1201.00. Special 17200 Records for \$1208.00. Special 17300 Records for \$1215.00. Special 17400 Records for \$1222.00. Special 17500 Records for \$1229.00. Special 17600 Records for \$1236.00. Special 17700 Records for \$1243.00. Special 17800 Records for \$1250.00. Special 17900 Records for \$1257.00. Special 18000 Records for \$1264.00. Special 18100 Records for \$1271.00. Special 18200 Records for \$1278.00. Special 18300 Records for \$1285.00. Special 18400 Records for \$1292.00. Special 18500 Records for \$1299.00. Special 18600 Records for \$1306.00. Special 18700 Records for \$1313.00. Special 18800 Records for \$1320.00. Special 18900 Records for \$1327.00. Special 19000 Records for \$1334.00. Special 19100 Records for \$1341.00. Special 19200 Records for \$1348.00. Special 19300 Records for \$1355.00. Special 19400 Records for \$1362.00. Special 19500 Records for \$1369.00. Special 19600 Records for \$1376.00. Special 19700 Records for \$1383.00. Special 19800 Records for \$1390.00. Special 19900 Records for \$1397.00. Special 20000 Records for \$1404.00. Special 20100 Records for \$1411.00. Special 20200 Records for \$1418.00. Special 20300 Records for \$1425.00. Special 20400 Records for \$1432.00. Special 20500 Records for \$1439.00. Special 20600 Records for \$1446.00. Special 20700 Records for \$1453.00. Special 20800 Records for \$1460.00. Special 20900 Records for \$1467.00. Special 21000 Records for \$1474.00. Special 21100 Records for \$1481.00. Special 21200 Records for \$1488.00. Special 21300 Records for \$1495.00. Special 21400 Records for \$1502.00. Special 21500 Records for \$1509.00. Special 21600 Records for \$1516.00. Special 21700 Records for \$1523.00. Special 21800 Records for \$1530.00. Special 21900 Records for \$1537.00. Special 22000 Records for \$1544.00. Special 22100 Records for \$1551.00. Special 22200 Records for \$1558.00. Special 22300 Records for \$1565.00. Special 22400 Records for \$1572.00. Special 22500 Records for \$1579.00. Special 22600 Records for \$1586.00. Special 22700 Records for \$1593.00. Special 22800 Records for \$1600.00. Special 22900 Records for \$1607.00. Special 23000 Records for \$1614.00. Special 23100 Records for \$1621.00. Special 23200 Records for \$1628.00. Special 23300 Records for \$1635.00. Special 23400 Records for \$1642.00. Special 23500 Records for \$1649.00. Special 23600 Records for \$1656.00. Special 23700 Records for \$1663.00. Special 23800 Records for \$1670.00. Special 23900 Records for \$1677.00. Special 24000 Records for \$1684.00. Special 24100 Records for \$1691.00. Special 24200 Records for \$1698.00. Special 24300 Records for \$1705.00. Special 24400 Records for \$1712.00. Special 24500 Records for \$1719.00. Special 24600 Records for \$1726.00. Special 24700 Records for \$1733.00. Special 24800 Records for \$1740.00. Special 24900 Records for \$1747.00. Special 25000 Records for \$1754.00. Special 25100 Records for \$1761.00. Special 25200 Records for \$1768.00. Special 25300 Records for \$1775.00. Special 25400 Records for \$1782.00. Special 25500 Records for \$1789.00. Special 25600 Records for \$1796.00. Special 25700 Records for \$1803.00. Special 25800 Records for \$1810.00. Special 25900 Records for \$1817.00. Special 26000 Records for \$1824.00. Special 26100 Records for \$1831.00. Special 26200 Records for \$1838.00. Special 26300 Records for \$1845.00. Special 26400 Records for \$1852.00. Special 26500 Records for \$1859.00. Special 26600 Records for \$1866.00. Special 26700 Records for \$1873.00. Special 26800 Records for \$1880.00. Special 26900 Records for \$1887.00. Special 27000 Records for \$1894.00. Special 27100 Records for \$1901.00. Special 27200 Records for \$1908.00. Special 27300 Records for \$1915.00. Special 27400 Records for \$1922.00. Special 27500 Records for \$1929.00. Special 27600 Records for \$1936.00. Special 27700 Records for \$1943.00. Special 27800 Records for \$1950.00. Special 27900 Records for \$1957.00. Special 28000 Records for \$1964.00. Special 28100 Records for \$1971.00. Special 28200 Records for \$1978.00. Special 28300 Records for \$1985.00. Special 28400 Records for \$1992.00. Special 28500 Records for \$1999.00. Special 28600 Records for \$2006.00. Special 28700 Records for \$2013.00. Special 28800 Records for \$2020.00. Special 28900 Records for \$2027.00. Special 29000 Records for \$2034.00. Special 29100 Records for \$2041.00. Special 29200 Records for \$2048.00. Special 29300 Records for \$2055.00. Special 29400 Records for \$2062.00. Special 29500 Records for \$2069.00. Special 29600 Records for \$2076.00. Special 29700 Records for \$2083.00. Special 29800 Records for \$2090.00. Special 29900 Records for \$2097.00. Special 30000 Records for \$2104.00. Special 30100 Records for \$2111.00. Special 30200 Records for \$2118.00. Special 30300 Records for \$2125.00. Special 30400 Records for \$2132.00. Special 30500 Records for \$2139.00. Special 30600 Records for \$2146.00. Special 30700 Records for \$2153.00. Special 30800 Records for \$2160.00. Special 30900 Records for \$2167.00. Special 31000 Records for \$2174.00. Special 31100 Records for \$2181.00. Special 31200 Records for \$2188.00. Special 31300 Records for \$2195.00. Special 31400 Records for \$2202.00. Special 31500 Records for \$2209.00. Special 31600 Records for \$2216.00. Special 31700 Records for \$2223.00. Special 31800 Records for \$2230.00. Special 31900 Records for \$2237.00. Special 32000 Records for \$2244.00. Special 32100 Records for \$2251.00. Special 32200 Records for \$2258.00. Special 32300 Records for \$2265.00. Special 32400 Records for \$2272.00. Special 32500 Records for \$2279.00. Special 32600 Records for \$2286.00. Special 32700 Records for \$2293.00. Special 32800 Records for \$2300.00. Special 32900 Records for \$2307.00. Special 33000 Records for \$2314.00. Special 33100 Records for \$2321.00. Special 33200 Records for \$2328.00. Special 33300 Records for \$2335.00. Special 33400 Records for \$2342.00. Special 33500 Records for \$2349.00. Special 33600 Records for \$2356.00. Special 33700 Records for \$2363.00. Special 33800 Records for \$2370.00. Special 33900 Records for \$2377.00. Special 34000 Records for \$2384.00. Special 34100 Records for \$2391.00. Special 34200 Records for \$2398.00. Special 34300 Records for \$2405.00. Special 34400 Records for \$2412.00. Special 34500 Records for \$2419.00. Special 34600 Records for \$2426.00. Special 34700 Records for \$2433.00. Special 34800 Records for \$2440.00. Special 34900 Records for \$2447.00. Special 35000 Records for \$2454.00. Special 35100 Records for \$2461.00. Special 35200 Records for \$2468.00. Special 35300 Records for \$2475.00. Special 35400 Records for \$2482.00. Special 35500 Records for \$2489.00. Special 35600 Records for \$2496.00. Special 35700 Records for \$2503.00. Special 35800 Records for \$2510.00. Special 35900 Records for \$2517.00. Special 36000 Records for \$2524.00. Special 36100 Records for \$2531.00. Special 36200 Records for \$2538.00. Special 36300 Records for \$2545.00. Special 36400 Records for \$2552.00. Special 36500 Records for \$2559.00. Special 36600 Records for \$2566.00. Special 36700 Records for \$2573.00. Special 36800 Records for \$2580.00. Special 36900 Records for \$2587.00. Special 37000 Records for \$2594.00. Special 37100 Records for \$2601.00. Special 37200 Records for \$2608.00. Special 37300 Records for \$2615.00. Special 37400 Records for \$2622.00. Special 37500 Records for \$2629.00. Special 37600 Records for \$2636.00. Special 37700 Records for \$2643.00. Special 37800 Records for \$2650.00. Special 37900 Records for \$2657.00. Special 38000 Records for \$2664.00. Special 38100 Records for \$2671.00. Special 38200 Records for \$2678.00. Special 38300 Records for \$2685.00. Special 38400 Records for \$2692.00. Special 38500 Records for \$2699.00. Special 38600 Records for \$2706.00. Special 38700 Records for \$2713.00. Special 38800 Records for \$2720.00. Special 38900 Records for \$2727.00. Special 39000 Records for \$2734.00. Special 39100 Records for \$2741.00. Special 39200 Records for \$2748.00. Special 39300 Records for \$2755.00. Special 39400 Records for \$2762.00. Special 39500 Records for \$2769.00. Special 39600 Records for \$2776.00. Special 39700 Records for \$2783.00. Special 39800 Records for \$2790.00. Special 39900 Records for \$2797.00. Special 40000 Records for \$2804.00. Special 40100 Records for \$2811.00. Special 40200 Records for \$2818.00. Special 40300 Records for \$2825.00. Special 40400 Records for \$2832.00. Special 40500 Records for \$2839.00. Special 40600 Records for \$2846.00. Special 40700 Records for \$2853.00. Special 40800 Records for \$2860.00. Special 40900 Records for \$2867.00. Special 41000 Records for \$2874.00. Special 41100 Records for \$2881.00. Special 41200 Records for \$2888.00. Special 41300 Records for \$2895.00. Special 41400 Records for \$2902.00. Special 41500 Records for \$2909.00. Special 41600 Records for \$2916.00. Special 41700 Records for \$2923.00. Special 41800 Records for \$2930.00. Special 41900 Records for \$2937.00. Special 42000 Records for \$2944.00. Special 42100 Records for \$2951.00. Special 42200 Records for \$2958.00. Special 42300 Records for \$2965.00. Special 42400 Records for \$2972.00. Special 42500 Records for \$2979.00. Special 42600 Records for \$2986.00. Special 42700 Records for \$2993.00. Special 42800 Records for \$3000.00. Special 42900 Records for \$3007.00. Special 43000 Records for \$3014.00. Special 43100 Records for \$3021.00. Special 43200 Records for \$3028.00. Special 43300 Records for \$3035.00. Special 43400 Records for \$3042.00. Special 43500 Records for \$3049.00. Special 43600 Records for \$3056.00. Special 43700 Records for \$3063.00. Special 43800 Records for \$3070.00. Special 43900 Records for \$3077.00. Special 44000 Records for \$3084.00. Special 44100 Records for \$3091.00. Special 44200 Records for \$3098.00. Special 44300 Records for \$3105.00. Special 44400 Records for \$3112.00. Special 44500 Records for \$3119.00. Special 44600 Records for \$3126.00. Special 44700 Records for \$3133.00. Special 44800 Records for \$3140.00. Special 44900 Records for \$3147.00. Special 45000 Records for \$3154.00. Special 45100 Records for \$3161.00. Special 45200 Records for \$3168.00. Special 45300 Records for \$3175.00. Special 45400 Records for \$3182.00. Special 45500 Records for \$3189.00. Special 45600 Records for \$3196.00. Special 45700 Records for \$3203.00. Special 45800 Records for \$3210.00. Special 45900 Records for \$3217.00. Special 46000 Records for \$3224.00. Special 46100 Records for \$3231.00. Special 46200 Records for \$3238.00. Special 46300 Records for \$3245.00. Special 46400 Records for \$3252.00. Special 46500 Records for \$3259.00. Special 46600 Records for \$3266.00. Special 46700 Records for \$3273.00. Special 46800 Records for \$3280.00. Special 46900 Records for \$3287.00. Special 47000 Records for \$3294.00. Special 47100 Records for \$3301.00. Special 47200 Records for \$3308.00. Special 47300 Records for \$3315.00. Special 47400 Records for \$3322.00. Special 47500 Records for \$3329.00. Special 47600 Records for \$3336.00. Special 47700 Records for \$3343.00. Special 47800 Records for \$3350.00. Special 47900 Records for \$3357.00. Special 48000 Records for \$3364.00. Special 48100 Records for \$3371.00. Special 48200 Records for \$3378.00. Special 48300 Records for \$3385.00. Special 48400 Records for \$3392.00. Special 48500 Records for \$3399.00. Special 48600 Records for \$3406.00. Special 48700 Records for \$3413.00. Special 48800 Records for \$3420.00. Special 48900 Records for \$3427.00. Special 49000 Records for \$3434.00. Special 49100 Records for \$3441.00. Special 49200 Records for \$3448.00. Special 49300 Records for \$3455.00. Special 49400 Records for \$3462.00. Special 49500 Records for \$3469.00. Special 49600 Records for \$3476.00. Special 49700 Records for \$3483.00. Special 49800 Records for \$3490.00. Special 49900 Records for \$3497.00. Special 50000 Records for \$3504.00. Special 50100 Records for \$3511.00. Special 50200 Records for \$3518.00. Special 50300 Records for \$3525.00. Special 50400 Records for \$3532.00. Special 50500 Records for \$3539.00. Special 50600 Records for \$3546.00. Special 50700 Records for \$3553.00. Special 50800 Records for \$3560.00. Special 50900 Records for \$3567.00. Special 51000 Records for \$3574.00. Special 51100 Records for \$3581.00. Special 51200 Records for \$3588.00. Special 51300 Records for \$3595.00. Special 51400 Records for \$3602.00. Special 51500 Records for \$3609.00. Special 51600 Records for \$3616.00. Special 51700 Records for \$3623.00. Special 51800 Records for \$3630.00. Special 51900 Records for \$3637.00. Special 52000 Records for \$3644.00. Special 52100 Records for \$3651.00. Special 52200 Records for \$3658.00. Special 52300 Records for \$3665.00. Special 52400 Records for \$3672.00. Special 52500 Records for \$3679.00. Special 52600 Records for \$3686.00. Special 52700 Records for \$3693.00. Special 52800 Records for \$3700.00. Special 52900 Records for \$3707.00. Special 53000 Records for \$3714.00. Special 53100 Records for \$3721.00. Special 53200 Records for \$3728.00. Special 53300 Records for \$3735.00. Special 53400 Records for \$3742.00. Special 53500 Records for \$3749.00. Special 53600 Records for \$3756.00. Special 53700 Records for \$3763.00. Special 53800 Records for \$3770.00. Special 53900 Records for \$3777.00. Special 54000 Records for \$3784.00. Special 54100 Records for \$3791.

Holding Device for an Automobile Gate

WHEN the front wheels of an automobile rock a gate flat to the ground, the top of the gate is caught by the catch until the rear wheels of the car pass over the gate. Running over the springboard *L* releases the catch *C* so that the gate rocks back into place again. Pressure



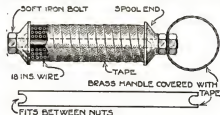
You don't have to get out of the car to unlock and push aside this gate. It opens and closes automatically

on *L* moves the angle-piece *A*, drawing the wire *R* taut and the catch *C* back. The gate pivoted between two posts is normally held upright by means of a counterweight *W*. The gate must be pushed down by hand for a horse-drawn vehicle, but it is automatically closed by passing over the springboards.—EDWARD R. SMITH.

A Magnetic Lifter for Engine Valves

WHERE a great many valves have to be removed from cages and enclosed ports, a magnetic valve-lifter will prove of real value. The core consists of a long soft iron bolt about 10 in. long by $\frac{1}{2}$ in. stock. Saw the heads off a large spool and run them on the bolt as shown, flattened surfaces of the heads facing toward each other.

Wind the bolt with several layers of heavily insulated No. 18 copper wire.



In garages, where many valves have to be ground, the magnetic valve-lifter is a time-saver. It is made from scraps

It is well to shellac each layer of wire before proceeding back over it with the next layer. Fill the space between the spool heads, and when completed wind with electric tape to keep out the moisture. Then run on one end until it forces the spool head in place against the coil. Bend the brass

Sargent Framing Squares

SARGENT Steel Framing Squares

Squares are the only squares which will calculate the lengths and cuts of Hip, Valley, Jack and Common rafters, without any figuring on the part of the carpenter.

Sargent Framing Squares are made of the finest tool steel and tested for trueness and accuracy. Made in nine dependable finishes. Ask for a Sargent Framing Square No. 500 series



WITH the first stroke of a Sargent Auto-Set Bench Plane the carpenter knows he has a superior plane in his hands.

Its rigid and true-cutting blade, its lack of chatter, its quick and easy adjustment for coarse or fine cuts, all recommend it to expert workmen.

In addition is the special Auto-Set feature which permits the blade to be removed, sharpened and replaced in exactly the same position and for the same depth of cut, without any readjustment whatever. Send for catalog showing the six sizes.

SARGENT & COMPANY

Hardware Manufacturers

50 Water Street, New Haven, Conn.



WIRE

electrical, rope, air-plane, piano, pipe-organ, flat, hoops, ball-they, tacks, nails, barbed-wire, concrete re-inforcement, springs, etc.

Illustrated Books Describing Uses, FREE

American Steel & Wire Co.

F. Rasmussen, P.O. Box 100, CHICAGO

LEARN ENGINEERING

Expert electrical engineers are being paid fabulous salaries—thousands needed today. We give you personal and thorough training—practical, technical courses 3 months to 2 years under expert engineers in electricity, steam, gas, armature winding, drafting, etc. Extensive laboratory and shop equipment. Not a trade school. Training is condensed—only one is limited come to the Finlay Engineering College—only one of its kind in the West. Day and night sessions—enroll any time. Write for FREE catalog, a post card will do.

1902 Indiana Ave. Kansas City, Mo.



Pilliod TOOL CASES EXCEL

Marinists, Tool Makers and Carpenters find them most satisfactory in construction, appearance, service and price. Immediate shipment.

Double describing 20 styles on request.

The Pilliod Lumber Co. Dept. A, Swanton, Ohio

ASBESTOS

We are miners and shippers of Crude Asbestos in any quantity. We produce all grades at our world famous BELL ASBESTOS MINES, in Canada. We also card fibres, spin yarns, weave cloths, and make all sorts of Asbestos products.

For anything you want in Asbestos, turn to KEASBEY & MATTISON COMPANY Dept. S-4, AMBLER, PENNA., U. S. A. Owners of the world's largest Asbestos Mines

Red Devil



Pliers No. 1950

Especially made for electricians, but valuable for heavy use of any kind. Have side cutters and can be used as hammer or wrench.



Pliers No. 999

A combination tool for handling pipes, wire, or for use as a hand vise. It is strong and heavy enough to serve as a hammer. "No Pinch" grip, and handles shaped to give you the strongest grip with the least exertion.

Booklet on Request

"Red Devil" is the Expert Mechanic's guide to known quality in Pliers, Electrician's Tools, Hack Saw Frames and Blades, Auger Bits, Chain Drills and other Hand Tools, all of a class with "Red Devil" Glass Cutters, the biggest sellers in the world.

"Red Devil" Corrugated Lock Washers have 6-point contact; they hold fast.

SMITH & HEMENWAY CO., Inc.

264 Broadway, New York, N. Y.

Factories: Irvington, N. J.

handle around as shown, slip over the bolt end, and secure with a second nut. A coat of shellac over the whole magnet will help to preserve it as well as add to its appearance.

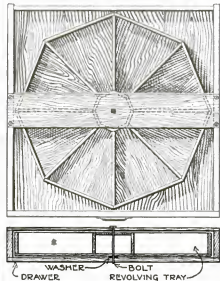
Connect to electric current, hold the bolt head over a valve head, and the entire valve can be lifted out of the seat by pulling on the handle of the magnet. With sufficient current this magnet can lift several pounds.

Winding the handle with tape will further protect the operator against any possible shock from short-circuiting.—L. B. ROBBINS.

Revolving Tool Drawer for the Mechanic

A DRAWER cannot usually be pulled out more than half its length with safety, especially when it contains tools or other heavy objects. The back part of the drawer is therefore of little use or is difficult to reach.

A mechanic has devised a combination that overcomes this difficulty. As shown in the illustration, there is first



Simply revolve the drawer until the particular tool you want comes under your hand

constructed a sliding drawer frame without a bottom, having a narrow board nailed across both top and bottom at the middle. The hexagonal set of compartments is fitted inside the sliding frame, so that it will revolve freely about a long bolt that passes through the center, and also through holes in the boards nailed across the top and bottom of the sliding frame. A washer made from a piece of 1-in. board fits beneath the revolving part in order that it may turn freely.

It will be necessary to pull such a drawer out only six or eight inches, and then to revolve the inner section until the proper compartment appears. This arrangement is particularly designed to hold bolts, nuts, screws, rivets, and small tools, and can be fitted beneath a work-bench top without occupying space otherwise needed.

WITTE ENGINES

Save \$15 to \$500

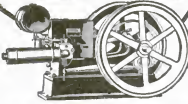
Built in the Largest Exclusive Engine Factory in the World Selling Direct. Quality and Service proven by 34 years success. You can always get delivery from Witte, and the best rig for the price. Write for latest catalog and enclosed WITTE Engines with

BOSCH Standard Ignition

I can furnish you a Stationary, Portable, or Saw-lig outfit—Kerosene or Gasoline—or a Lever-Controlled Drag Saw with all latest improvements. Witte Engines are regularly equipped with H. T. battery, or Standard BOSCH Magneto on order. Lifetime Engine Guarantee against defect—no strings—no time limit—no excuse. Tell me what you want and when you want it. I can ship quicker than any other factory selling direct.

WITTE ENGINE WORKS

Kansas City, Mo. Pittsburgh, Pa.
2225 Oakland Ave. 2225 Empire Bldg.



IF YOU HAVE METAL TO CUT YOU NEED

BARTLETT COMPRESS-POWERED SNIPS \$2 to \$6.70

Made of high grade American Tool Steel, accurately ground and polished up to 16 gauge finish. 1 inch \$2.00, 1 1/2 inch \$2.50, 2 inch \$3.00, 2 1/2 inch \$3.50, 3 inch \$4.00, 3 1/2 inch \$4.50, 4 inch \$5.00, 4 1/2 inch \$5.50, 5 inch \$6.00, 5 1/2 inch \$6.50, 6 inch \$7.00. Your own choice in size, shape or color. Can cut steel, brass, copper, lead, tin, zinc, aluminum, etc. Will ship prepaid in U. S. or by express. FOLDER ON REQUEST

BARTLETT MFG. CO., 31 E. Lafayette Ave., Detroit, Mich.

Quality First

TOOL CASES

for Machinists and Toolmakers

Write for our booklet showing the best built and most practical selection of Tool Cases on the market. We ship direct from factory and guarantee to please you or refund.

The Tool Case Co.
60 Columbia St., Dayton, Ohio

CHARGE Big Profits For You

Auto Storage—\$100 to \$200 Extra Profit Every Month. 100 watt Charger recharges 1 in 2 batteries at once with current out of the line for safety. Automatic per to \$1.50.

\$15 For The Money Maker in Your Garage. Recharge 100 watt monthly payments. You can make money every month. Write for details. Money-Back Guarantee. This is today. Hobart Brothers Co., Box 542, Troy, Ohio

Write for our booklet showing the best built and most practical selection of Tool Cases on the market. We ship direct from factory and guarantee to please you or refund.

The Tool Case Co.
60 Columbia St., Dayton, Ohio

One Man Saws 25 Cords a Day

The Ottawa Log Saw does the work of ten men. Makes wood moving easy and profitable. When sawing wood use for pumping, feed grinding, etc. Simple, economical, durable. Thousands in use. Fully guaranteed, 30 days trial. Write at once for Free book and low price. OTTAWA MFG. CO., 1801 Wood St., Ottawa, Kan.

AUTOMOBILE IGNITION, VALVE TIMING, SELF-STARTING AND LIGHTING, INCLUDING FORD SYSTEM

A manual of the care, adjustment and repair of the automobile electric system, covering both the ignition and self-starting systems. It can be easily understood by one who is not at all acquainted with electrical principles, for the subject is taken up progressively from the most elementary descriptions of electrical circuits to the most complicated starting systems in many steps. The chapter on valve timing is a remarkable feature. It gives information on the proper valve adjustments for a great number of modern cars. Price, postpaid, \$1.50. Book Department, Popular Science Monthly, 225 West 39th St., New York



The Micrometers Story

1867
1920

Did You —Ever Know

that away back in 1867 Messrs. J. R. Brown and Sharpe brought from Paris an idea which resulted in what is now the most necessary tool in the mechanical world —the Micrometer Caliper?

That today there are over 100 different types of Micrometers—the result of many years of study and improvement?

This information is told in a most interesting way in our latest booklet, "The Micrometer's Story." After reading it you will understand why

BROWN & SHARPE

Machinists' Tools

are recognized throughout the world as the machinists' favorite.

If you are interested we will send you a copy of the booklet along with our catalog No. 27 which lists over 1000 tools.

Brown & Sharpe Mfg Co
Providence, R.I.

Consider the Top of Your Automobile

WHEN the top of your car is neglected it becomes shabby in a very short time, detracting from its appearance and value should you wish to trade it in for a new car. This is absolute carelessness, because with a little consideration and care the top can be made to stand up as long as the body or the running gear.

Never fold the top when it is wet, for there is always the possibility of mold or mildew attacking it, and this results in rapid deterioration. When the car is laid up for any length of time, the top should always be left up, to preserve its shape. Use the slip cover whenever the top is folded. Everyone knows that the vacuum



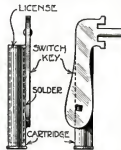
There may be a fine car under that shabby automobile top, but the outsider isn't likely to get that impression

created at the rear of the car when it is in motion fills the uncovered top with dust and dirt.

Mohair tops should be cleaned by brushing thoroughly with a whisk-broom and eradicating the spots with a sponge, warm water, and castile soap. A chamois wrung dry will finish the job by taking up the excess moisture.—R. L. PRINDLE.

A Combined Switch-Key and License-Holder

INSTEAD of going out automobilizing without your driving license, nine times out of ten, why not keep it in a place where you could not drive and be without it? An empty cartridge soldered to the switch-key makes an ideal place in which to keep the license.



You can't possibly lose your automobile license if it is attached to the switch-key

tridge to one side of the key, opening uppermost. Then roll the license into a little spill, and slip it into the cartridge, closing with a cork stopper if desired.

The license will always be with you when driving and cannot become mislaid as long as the key is in your possession.—WINDSOR CROWELL.

FORGING— Ancient and Modern

SINCE the olden days when armors of Damascus forged on anvils, with hand-hammers, their world-famed swords, the Art of Forging has developed into a gigantic modern industry. The smith and his puny hand-hammer have been supplanted by powerful machines that forge great crankshafts, as well as smaller pieces, in dies. The drop-hammer's mighty force has replaced the blacksmith's arm of brawn. And rightly so. For the process of Drop-Forging insures far greater strength and accuracy, better quality and speedier output in wrought metal parts than would otherwise be possible.

In the manufacture of Williams' Superior Drop-Forgings and Drop-Forged Tools is employed the most improved mechanical equipment, backed by engineering knowledge, technical skill and experience—experience gained during nearly half a century in the constant effort to maintain the high standard established for Williams' product.

Booklets describing our Superior Drop-Forged Wrenches, "Vulcan" and "Agrippa" Machinists' Tools and Pipe Fitters' Tools will be mailed, free, on request.

J. H. WILLIAMS & CO.

"The Drop-Forging People"

7 Richards Street, - Brooklyn, N. Y.
7 South Clinton Street, - Chicago, Ill.
7 Vulcan Street, - - Buffalo, N. Y.



WILLIAMS' SUPERIOR DROP-FORGED WRENCHES

40 Standard patterns in about 1000 sizes with openings $\frac{3}{16}$ to $\frac{7}{8}$ inches.
Write for our new Wrench Book.

Is Your Machine Under-estimated

THAT productiveness which puts your machine ahead of the next best—is it a matter of *record* with the user of the machine?

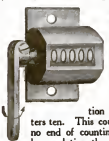
Can the best rate-of-work be checked-up by the operator—and kept up by comparative records of his work?

There's the need of a

The Veeder COUNTER

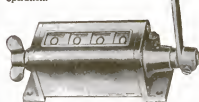
—to give the owner and operator the *full measure* of your machine, keeping adjustments and operating methods up to the point of efficiency.

This small Rotary Ratchet Counter (No. 6) counts reciprocating movements of the lever,



as required in recording the output of punch presses. When the lever is moved through an angle of 40 to 60 degrees, the counter registers one. A complete revolution of the lever registers ten. This counter is adapted to no end of counting purposes, simply by regulating the throw of the lever. Price, \$2. (Cut nearly full size.)

The Revolution Set-Back Counter below is designed for larger machines, where a shaft-revolution indicates an operation.



Registers one for each revolution of shaft, and sets back to zero from any figure by turning knob once round. Supplied with from four to ten figure-wheels, as required. Price, with four figure-wheels, \$9.00 (subject to discount). (Cut less than 1/2 size.) Set-Back Rotary Ratchet Counter of similar size and type, \$10.50 (list).

Other Veeder Counters are supplied according to your requirements, in great variety of size and style. Let us send you the new illustrated booklet.

The Veeder Mfg. Co.
44 Sargeant St., Hartford, Conn.

A New Way to Lay Off Bolt-Holes

WHEN dividing a circle into an even number of equal angles—as in laying off bolt-holes—the following procedure will save much time.



Suggesting an easy way of laying off bolt-holes on a drawing

Suppose that you wish to lay off sixteen bolt-holes around a circle (see illustration). By using the 45-degree triangle and T-square in the usual manner, eight of these holes can be located—as at A, B, C, D, E, F, G, and

H. Now, instead of bisecting the arc between A and B with compasses or dividers, it can be done by joining A and F by means of a triangle and sliding the triangle parallel to itself into the position OX. This construction depends upon the geometrical theorem that an angle inscribed in a circle is equal to one half of the central angle standing on the same arc. Thus we have angle XOB equal to angle AFB equal to one half angle AOB.

In the same manner, the points Y, Z, etc., may be located by successively joining the center of each hole with the far end of the diameter through the next hole. If it is necessary to lay off thirty-two holes, the process may be repeated to bisect the arcs AX, XB, BY, etc., and repeated again for sixty-four bolt-holes.

By the use of a 60-degree triangle, twelve bolt-holes can be located from the T-square, from which other points can be laid off for 24, 48, 96, etc., bolt-holes successively.—F. M. WESTON.

Rubber Nipples Make Fine Insulators for Test Clips

SOMETIMES test clips or test points are attached to lines carrying somewhat heavy voltage, heavy enough to seem disagreeable if accidentally passed through the body. In that case insulators near the terminals where handled are convenient.

A good temporary insulator can be made of a rubber nursing nipple. Simply enlarge the hole in the nipple and run the wire through it until the clip or point just emerges from the large end.

The clips can then be handled with perfect safety.—WINDSOR CROWELL.



A rubber nursing nipple prevents the current from leaking through

Electricians' Knife Scissors and Tweezers

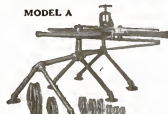
We can meet dealers' demands at once and offer attractive quantity prices

Write for description

MATHIAS KLEIN & SONS, Mfrs.
CANAL ST. 3, CHICAGO

POWER BENDERS TWO NEW MODELS

MODEL A



"Wonder" Cold Pipe Bending Machines (pat.) electrically operated to bend from 1" to 8". Send for printed matter. We also manufacture TEN other sizes hand operated to bend from 1/8" to 6".

American Pipe Bending Machine Co. 31 PEARL STREET Boston, Mass., U.S.A.

BIG PROFITS for YOU in HB BATTERY CHARGING

Battery charging is a wonderfully profitable business that you can handle without any special electrical or mechanical experience. With no better opportunity than yours, many HB owners are clearing \$100 to \$150 EXTRA PROFIT Every Month. Some even more. Take HB 500-watt Charger and charge 1 to 5 auto storage batteries at once with current out of only 10 to 15 for power battery. Auto repair shops like it. No risk. Absolute money back guarantee. Do it today.

\$15 Pays This Money-Making Machine in Your Earnings
Batteries in your shop should be charged. They should be charged more than most all anywhere. Write for full particulars or send \$15 first payment with trial order. Includes money back guarantee. No risk. Absolute money back guarantee. Do it today.

HOBART BROTHERS COMPANY

Box 341 Troy, Ohio

RICHARDSON'S POLYPHASE SLIDE RULE



Has the regular A, B, C and D Scales; also a CT or Inverted Scale, Logarithm, Sine and Tangent Scales. All graduations are printed on white coated steel from machine divided plates. These Scales are accurate and will retain their accuracy indefinitely. They are not affected by acids, alkalies, water or grease. Length of rule 10 inches. A 100 page Instruction Book, which teaches all there is to know about slide rules, is sent with each order. Price of the Richardson's Polyphase Slide Rule, in case, with a 100 page Instruction Book, \$2.00.

An ideal slide rule. It is low-priced and an equal to any other rule in accuracy, accuracy and durability. Be convinced. Your money will be promptly refunded if you are not satisfied.

GILSON SLIDE RULE CO., Niles, Mich.

STAR STORAGE BATTERIES

More Dependable Lower in Price

The BEST Guarantee

Liberal discounts to dealers;

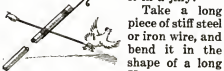
write for particulars

THE STAR STORAGE BATTERY COMPANY

Manufacturers of Automobile Starting and Lighting Batteries MUNCIE, IND. U. S. A.

The Poultry Hook is a Great Labor-Saver

ONE simple labor-saver for the poultryman is a hook for catching birds. Any amateur mechanic can make it in a jiffy.



Simply lean over the fence and catch the chicken by the leg

Take a long piece of stiff steel or iron wire, and bend it in the shape of a long U. The open end of the U should then be turned back, so

the sharp end of the wire will not injure the bird's legs.

Fasten the hook to a strong but light pole, and the hook is ready for business.

The hook is slipped around the fowl's leg, and slides down to the foot, where it holds until the poultryman can walk up and pick up the bird with his hands.

A simple but efficient aid in the poultry-yard.—L. B. ROBBINS.

Automobile Economy—What It Means

WHEN the topic of economy is discussed among a group of motorists, it is often found that only the type of economy secured by high gasoline mileage is referred to. The other factors of economy are frequently forgotten either in purchasing or using a car. Let us examine them in order.

First, economy is an all-inclusive term. In some respects it is synonymous with good investment and dollar-for-dollar value. In its broader sense you must consider performance, comfort, and good looks when obtained at a medium price.

Sturdiness of construction and proper workmanship reduce your repair charges—in most cases an important economy feature. Accessibility of adjustments and lack of complicated mechanism reduce your upkeep to a minimum—another fact to be remembered.

The increase in gasoline mileage secured by proper preheating of fuel is worthy of note at this time when the quality of gasoline is low. Easy starting and great flexibility in high gear save much gasoline.

Scientific distribution of light weight not only increases gasoline mileage but adds miles to the usefulness of your tires. The cost often takes precedence over fuel expenses, and the ratio of car weight to standard tire equipment should be considered by the intelligent buyer.

Every motorist realizes the possibilities for economy in his every-day driving, but these few suggestions may remind him of several factors that should be thought of under the subject of economy.

To cut down the cost per cut

How Many S. P. M.?

"Haste makes waste" is just as true of hack saws as of anything else. Forcing a blade by increasing the strokes per minute means a quickly dulled blade. 50 to 60 strokes per minute is about as fast as it is economical to run when cutting dry. On soft steel, using compound, saws may be run to advantage at about 100 S. P. M., at from 65 to 80 on annealed steel, and on unannealed tool steel at about 60 to 80 strokes per minute.

Follow the Starrett Hack Saw Chart, put on the weight and watch the cutting cost decrease.

THE L. S. STARRETT CO.

The World's Greatest Toolmakers
Manufacturers of Hack Saws Unexcelled
ATHOL, MASS.



the speed



Use Starrett Hack Saw Blades



WIN A \$500 SCHOLARSHIP. If you wish to compete for one of Popular Science Monthly's \$500 scholarships, ask your school principal to send in your name before April 1, 1930. Full particulars on request. No writing Committee, Popular Science Monthly, 225 West 39th Street, New York.

HANCOY ATLAS OF THE WORLD. Printed from brand new plates with maps in 8 colors. Water to show Mountains in relief—used as Railroads named. Price in cloth \$1.00 and in leather \$1.50. For sale by the Book Department, Popular Science Monthly, 225 West 39th Street, New York.

NEW MOTORS

FACTORY GUARANTEED - ALL SIZES - IN ORIGINAL BOXES

Your Opportunity

To Buy New Guaranteed Electrical Apparatus of Standard Manufacturers

Single Phase Motors	Charging Generators	Polyphase Motors	Battery Charging Outfits
110-500 volts, A.C. 60 cycle, 3000 R.P.M. with pulley	Suitable for all lighting, Battery, Charging, and Power Requirements.	2 and 3 phase, A.C. 440 v, 60 cycle, 1725 RPM, complete with base and pulley.	To operate on A.C. 60 cycle, made phase voltage as specified.
1/4 H. P., 110 volts, induction, full load start - -	8 volts, 10 amp. - -	1/4 H. P. - -	110 volts, A.C. 110 watt, 34 volts without rainboard - -
1/2 H. P., 110-220 volts, induction, full load start - -	10 volts, 10 amp. - -	1/2 H. P. - -	110 volts, A.C. 110 watts, 34 volts without rainboard - -
1/2 H. P., 110-220 volts, repulsion, sliding base - -	10 v, 7 1/2 amp. - -	3/4 H. P. - -	110-220 volts, A.C. 110 watts, 34 volts without rainboard - -
1 H. P., 110-220 volts, repulsion, sliding base - -	10 volts, 15 amp. - -	1 H. P. - -	110 volts, A.C. 220 watts, 34 volts without rainboard - -
2 H. P., 110-220 volts, repulsion, sliding base - -	110 volts, 15 amp. - -	3 H. P. - -	110 volts, A.C. 220 watts, 34 volts without rainboard - -
3 H. P., 110-220 volts, repulsion, sliding base - -	110 volts, 25 amp. - -	5 H. P. - -	220 volts, A.C. 440 watts, 44 volts without rainboard - -
5 H. P., 110-220 volts, repulsion, sliding base - -	110 volts, 35 amp. - -	10 H. P., high speed, 3600 R.P.M., 220 v. - -	220 volts, A.C. 440 watts, 44 volts without rainboard - -
	Moving Picture Arc Generator	2 phase only - -	
	\$85.00		

WRITE FOR CATALOG. BARGAIN IN MOTORS AND GENERATORS

1/4 H. P. SPECIAL
110 volts, 15 amp. - -
A.P. 1750 RPM.
Complete and ready to run

\$19.75 EACH

MONKEY BACK GUARANTEE

SHIPPING TERMS: 10% discount required on all orders. Balance C. O. D. by Express. Split draft with Bill of Lading attached by freight.

MANUFACTURER'S DISTRIBUTOR
CHAS. H. JOHNSTON, Box 24, West End, Pittsburg, Pa.

WASHING MACHINE MOTORS
Specially designed for washing machines, 1/2 H. P., 110 volts, 15 amp. - -
Complete and ready to run

\$19.75 EACH

MONKEY BACK GUARANTEE

SIMONDS



Edgeholding

—all of them: Compress blade, keyhole blade, and that all-purpose 18" blade made for cutting either wood or metal.

A handy kit for contractors on roof, or floor, or any kind of repair work entailing nail and metal work cutting.

Edgeholding—the outstanding quality of Simonds Saws—because of the Simonds made steel that's in them.



Simonds Manufacturing Co.
Fitchburg, Mass.

"The Saw Makers," Established 1832

CHICAGO, ILL.	VANCOUVER, B. C.
NEW YORK CITY	LONDON, ENG.
PORTLAND, ORE.	MONTREAL, QUE.
LOCKPORT, N. Y.	MEMPHIS, TENN.
NEW ORLEANS, LA.	SEATTLE, WASH.
SAN FRANCISCO, CAL.	ST. JOHN, N. B.

SIMONDS SAW STEEL PRODUCTS
MADE RIGHT SINCE 1832

What Do You Know About Your Car's Electric System?

DESPITE the fact that a well built electric lighting and starting system gives little trouble, it is important that the devices provided by the manufacturer to indicate derangement be watched. It is almost as easy to form the habit of looking at the indicators as it is to form the habit of ignoring them.

Self-starters at present are very reliable; nevertheless, that does not mean that this device does not need careful attention. The electrical appliances used have a number of important bearings and points of adjustment that need careful attention. One should make it a point to familiarize himself with all the details regarding the electrical system, and inspect them carefully at frequent intervals. By so doing a lot of trouble and expense will be done away with.

Most self-starting systems have a fuse-box installed at an accessible point. The purchaser of a new car should acquaint himself with this as quickly as possible. Very often considerable trouble is eliminated by the installation of a new fuse. This is a simple matter, but its neglect may cause a lot of trouble and unnecessary expense.

Modern cars are equipped with electric self-starters and do not have the crank handle installed. Without a crank handle it is difficult properly to test the compression of each cylinder. Often a motor is run with weak cylinders simply because it is too much trouble to attach the crank handle and test the compression of each cylinder. If the compression of each cylinder is not kept up to standard there is bound to be more or less of a pound in the engine, which is injurious to all the working parts, this being true especially of the bearings.

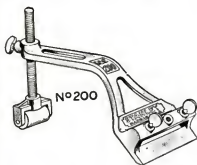
When the self-starting device fails to start the engine after reasonable trial, the trouble should be located without delay. One cannot expect too much from a small battery. The self-starter is not supposed to crank the engine indefinitely. Bear this in mind and you will prolong the life of your battery.

Many times a troublesome skip in a cylinder is due to an unsuspected leak in the high-tension wire. When hunting for such trouble, go over the wires carefully, raising them slightly from any place where there might be a leak. When found, the place must be covered with electric tape, unless a new wire is installed.

If the wire runs through a metal tube it will not be possible to trace the whole length of it, so it must be removed from the tube and connected as before.

By running the engine and going over the wire inch by inch, the leak should be discovered. If it is not

Stanley Tools



Stanley Cutter and Chisel Grinder

The STANLEY CUTTER AND CHISEL GRINDER is a device for holding Plane Irons, Chisels, and other similar cutting tools that they may be ground or honed to any desired angle or bevel, insuring an accuracy that is very difficult to obtain when the tool is held in the hand.

The tool to be sharpened is rigidly held in the Grinder by thumb screws, and may be given any desired angle by means of the large screw attached to the roller frame, which raises or lowers the main body.

As shown in the cut the Grinder is fitted with two thumb screws and three thumb screw holes. By the use of the two thumb screws, the tool to be ground is held much more firmly than is possible with the use of a single screw.

The Sharpener is made entirely of metal, all parts being nickel plated.

Special circular upon request

STANLEY RULE & LEVEL CO.
NEW BRITAIN, CONN. U.S.A.

This One



3631-894-05TF

strong enough to give a spark it may be found by passing the fingers along its length. A slight shock will indicate the trouble instantly.

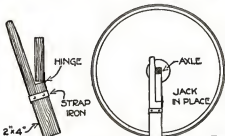
Braided insulation is particularly liable to pick up moisture and short-circuit every time it rains. When the missing cylinder is located you should parallel the wire—that is, lay a new or perfect wire from distributor to plug. Disconnect the old one and the engine should pick up speed and the missing should stop.

The safety spark-gap of a magneto rarely gives trouble, but it may at some time. It has too much resistance in ordinary circumstances, but if the gap in the spark-plug burns too wide it will be easier for the current to short-circuit through the safety gap. Run the engine and listen carefully for a spark. If it occurs, look at the gaps of the plugs and set all of them to the thickness of an old hacksaw blade.

Some drivers prefer a larger gap than the hacksaw blade will give. The usual blade is about one fortieth of an inch, or .025. This is right for magneto, but one thirty-second may be used with battery ignition. Since the gap never closes up, but always burns larger, it is evident that a smaller rather than a larger gap is preferable. For the magneto a small gap is necessary; otherwise the engine will miss explosions at low speed.

Why the Homemade Wagon-Jack is Best

THE worst thing about most wagon-jacks is the time it takes to get them adjusted and set in place. On a ranch where a number of hay-racks were in more or less constant use, a



Why buy the manufactured kind when you can make a wagon-jack suited to your particular need

simple jack was made to raise the wheels from the ground preparatory to greasing them.

The jack was made by sawing a 2-by-4-in. piece of wood as shown in the illustration, hinging the cut-out portion, and bolting a thin piece of strap-iron about it to prevent splitting the wood.

The hinged piece was so cut that the upper end came two or three inches above the bottom side of the axle when it rested upon the ground. This was placed under the axle, and the lever arm raised until the two came together, locking itself and holding up the wheel.—DALE VAN HORN.

GOODELL-PRATT

1500 GOOD TOOLS

All-Steel Mitre Box *made to give Real Service*

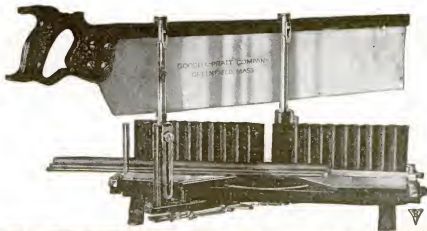
WE have been making these Mitre Boxes for ten years. During all this time, repairs and replacements have been practically nothing.

Our Mitre Boxes are built entirely of steel and trussed like a bridge. This construction eliminates the possibility of breakage from any cause and enables the tool to retain its accuracy for practically a lifetime.

The saw may be locked at any desired angle. It can be held in an elevated position by a spring lock, which is easily released by a slight downward pressure. Stops can be readily regulated to permit sawing to any desired depth. These are a few of the good points of the Goodell-Pratt All-Steel Mitre Box, but there is but one way to really appreciate this tool and that way is to ask your dealer to show it to you.



Complete pocket-edition catalogue sent on request



GOODELL-PRATT COMPANY

Greenfield, Mass., U.S.A.



Radiator Cement

In liquid form and easy to use. Will ordinarily seal leaks in from two to ten minutes.



Hastee Patch

A quick, permanent, inexpensive repair for tubes and castings. Can be applied in three minutes at a cost of 2 cents.



Valve Grinding Compound

Will remove pits and foreign substances from valves, giving a velvet seat. Will not cut grooves.



Carbon Remover

An occasional dose will stop that knock—quiet the motor—and save the batteries. You can do it yourself in ten minutes.

Keep Your Car Young

It isn't fair to yourself or to your car to run it without any attention and then sell it at a big loss. With but little effort you, yourself, can keep your car in such condition that the depreciation will be very slight. We offer for your use **Johnson's Car Savers**. No experience is necessary for their use. They can all be applied by the amateur with perfect satisfaction.

Johnson's Car Savers are of the very highest quality that can be produced. You will find cheaper make-shifts on the market, but when you insist upon **Johnson's** you are taking no chance, for all of our preparations are fully guaranteed.

JOHNSON'S Car Savers

Start today to reduce the depreciation of your automobile. An hour or two every month and **Johnson's Car Savers** will prove their value in dollars and cents when you come to sell or turn in your car.

Johnson's Car Savers have been on the market for several years. Millions of cars have been used by motorists everywhere with entire satisfaction. For years our employees have been our partners and share the profits. Because of this personal interest unusual care and skill enter into the manufacture of the **Johnson** products—overhead is reduced to the minimum and we are enabled to sell at a very slight increase over pre-war prices, notwithstanding the tremendous advances on all of our raw materials.

Representative dealers and jobbers all over the world handle **Johnson's Car Savers**. Don't accept or handle unknown substitutes. Write for our booklet "Keep Your Car Young"—It's free.

S. C. JOHNSON & SON

Dept. P. S. M. 4, RACINE, WISCONSIN



Top Dressing

Johnson's Black-Lac is the ideal top dressing. One coat imparts a rich, black surface just like new.



Auto-Lak

A splendid elastic varnish for bodies, hoods and fenders. A coat will increase the value of your car from 10% to 35%. Dries in 24 hrs.



Stop Squeak Oil

It seeps between the springs, thoroughly lubricating them. Makes your car ride easier, reduces the liability of spring breakage.



"What's a bath without a Topkis, eh, Bob?"
 "You SAID something, Frank!"

A WILTING round of golf, or a vicious match of tennis. The reviving drench of the needle-shower, then into a fine, fresh suit of toppy Topkis, to make the exercise worth while.

And Topkis, more than any other? Assuredly. For Topkis is fashioned from first-quality nainsook with the utmost skill of the needle craft, deliberately designed for body-freedom. The prices are exceptionally reasonable, too! That is Topkis, exclusively.

Topkis comes in unions at \$1.65, also shirts-and-drawers at \$1.00 the garment. Available at quality shops. You'll want a half dozen suits at least. Especially at the low Topkis price. Genuine Topkis has the red-diamond label.

TOPKIS BROTHERS COMPANY
 WILMINGTON, DEL.

General Sales Offices, 350 Broadway, New York City
 Also Makers of Women's, Children's and Boys' Athletic Underwear

TOPKIS
 Athletic Underwear

Copyright 1919, Topkis Brothers Company



Shirts-and-Drawers
 \$1.00 each



Union Suits
 \$1.65 each



We make MURADS of 100% Pure Turkish tobacco to give 100% enjoyment to smokers of 100% good taste.

"Ordinary" cigarettes cannot be 100% Turkish—and you cannot afford to smoke cheap quality cigarettes.

There can't be a better cigarette than MURADS till the world finds a better cigarette tobacco than Turkish—and that does not exist!

"Judge for yourself—!"

Anargyros

Makers of the Highest Grade Turkish
and Egyptian Cigarettes in the World